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LITHOTRITY AND LITHOTOMY

COMPARED;

BEING

AN ANALYTICAL EXAMINATION

OF THE PRESENT METHODS OF TREATING

STONE IN THE BLADDER,

WITH

SUGGESTIONS FOR RENDERING LITHOTRITY APPLICABLE TO THE DISEASE IN ALMOST ALL ITS STAGES AND VARIETIES, AND REMARKS ON THE GENERAL TREATMENT OF GRAVEL AND STONE.

BY

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LONDON:

PUBLISHED BY LONGMAN, REES, ORME, BROWN AND GREEN, PATERNOSTER ROW.

1832.

567.

Printed by J. M'Gowan, Great Windmill Street, Haymarket.

TO

DR. KOREFF AND DR. A. MENTONNIER HAWKINS,

THIS WORK IS INSCRIBED

WITH

FEELINGS OF GRATITUDE AND ATTACHMENT

BY

THE AUTHOR.

PREFACE.

I believe no class of men are put to a severer trial, and yet, on whom it is more incumbent to preserve a calm and correct judgment in the exercise of their profession, than they who undertake the treatment of disease. To be placed almost constantly in presence of affliction requires a sacrifice, to which few could submit, were it not for the gratification derived from relieving it. But when a painful disease exhibits itself, in such a form that it can be removed only by remedies more or less severe and dangerous, and that there exists any doubt as to the choice of

these, the task of the Surgeon or Physician becomes anxious and difficult in the extreme. Such a disease is stone in the bladder, at the present moment. Until within the last few years, we had no other means of obtaining any thing like an effectual cure of this cruel disorder, than by cutting into the bladder,—an operation, which, however well performed, or by whatever method, is confessed, on all sides, to be pregnant with danger and dreadfully painful. Fortunately for mankind, it has at last been discovered, that this operation may be dispensed with, and that it is practicable and safe, without a wound of any kind, to reduce a stone in the bladder, to such a state, that it will pass away through the natural passage.

However, like all valuable discove-

ries which are new and unexpected, this plan has met, if not with direct opposition, at least, with a reception somewhat reluctant. From what causes may be easily conceived. The custom of cutting into the bladder to remove the stone, having existed for centuries, had created and sustained a kind of habitual conviction, among Surgeons, that nothing less than Lithotomy could be efficient; therefore, the new plan was received and examined with considerable distrust. Upon consideration *a priori*, it was something like expecting a miracle, to suppose that the bladder would submit to any process necessary to reduce a calculus to powder and fragments, by mechanical means; and scarcely less impossible did it appear that instruments could be made strong enough to be adequate to the purpose, and, yet, sufficiently

delicate to be worked in this organ without seriously injuring it. Even after the instruments had been actually invented, and applied on the dead subject, many a good Surgeon would exclaim, when they were put into his hand, "This will never do." M. Civiale, however, persevered—and to his praise be it spoken—proved that it would do. After the practicability of the thing was admitted, it was contended, and still is contended by many,—that the new operation is not preferable to the old one,—that the nicety of tact required in the performance of it will ever prevent its general practice, —that, at best, it is applicable only to a certain class of cases,—that, as it is performed without the advantage of optical direction, it will always be unmanageable and liable to dangerous accidents. These and other ob-

jections have rendered its adoption, (especially in this country,) partial and tardy. Even at the time I am writing this preface, patients in our public hospitals are being subjected to Lithotomy. Under these circumstances I have been induced to bring the question fairly before my professional brethren,—to compare the new methods, and attempt to try them by the test of reason and experience; and, by a careful examination of the parts concerned, and of the nature of the disease considered surgically and physiologically, to arrive at some definite conclusion as to the value of each operation, the possibility of improving it, and the cases to which it is applicable. Having been for many years engaged upon one of the largest theatres in the world for medical and surgical practice, where a great number of calculous disorders came

under my observation, I was naturally led to reflect much upon the means employed for their cure; and being occupied at the same time in teaching anatomy, attended particularly to the structure of the parts interested, which are certainly the most intricate of any in the body. The more familiarity I acquired with the subject, the greater was my emotion on witnessing, or performing Lithotomy, because the more deeply was I impressed with the inevitable dangers attending it. At that period, being also a member of several societies in Paris, where the merits of Lithotrity were often discussed, my attention was necessarily directed to a comparison of the two methods of operating.

Ten years have now elapsed since Lithotrity was brought under the

consideration of the Academie de Medicine, and ample opportunities have been afforded for trying its efficacy; it is hoped, therefore, that the present treatise may not be considered premature, or the opinions it contains hastily formed. I have taken Anatomy as the foundation whereon to rest those conclusions which have been furnished by as full and impartial an examination of the matter as I am capable of. In the description of the urinary apparatus and its functions, which is that I have been accustomed to give in my lectures, will be found some new points till now unpublished, and which I owe to the great opportunities of dissecting afforded by my situation in Paris. There will appear, in this description, certain coincidences with, and some differences from that given by Baron Heurteloup: for the former, I am glad

to have the sanction of his authority; and the latter I leave to be decided by the dissector's knife.

Throughout the whole work, and particularly in describing the different operations as I have been in the habit of performing and demonstrating them, I have endeavoured to be as brief and concise as was consistent with clearness and accuracy, satisfied that in these matters, and especially for the purpose of comparison, it is essential to avoid all superfluous details, in which main facts are but too often smothered.

To arrive at right conclusions I found it best to condense the evidence, and although this is arranged within a very small compass, it has been my care to omit nothing important. Unlike a general, who, having

weak means of defence, is compelled to use his skill, in deceiving the enemy, by making shew of an extensive force, I have been able to dispense with all parade, trusting to positions strong in their nature and requiring no artificial protection.

In pronouncing a judgment upon the divers plans of performing Lithotomy, I have been guided by no other motive than the desire of ascertaining the truth; and the new operations which I have ventured to propose, as well as the suggestions thrown out respecting the causes and general treatment of gravel and stone, are submitted to the profession with that diffidence which the importance and difficulty of the subject naturally inspire, and with a sincere and earnest hope that they may not prove altogether unprofitable.

To obtain the few (but I hope well earned) honors which I owe to the principles of justice and liberality regulating the Public Medical Institutions in France, and, in contending for which, I had to appear at least five and twenty times in public examinations (Concours Publics,) I necessarily contracted the habit of speaking, writing, and thinking, in French; and this is the best apology I can offer for the style in which the book is written.

I cannot conclude without acknowledging, that I have derived much assistance and encouragement in composing this work, from the kindness of several friends, whose amity will ever be the solace and pride of my life.

Hanover Street, Hanover Square.

February, 27, 1832.

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ERRATA.

Page 3	(Note)	for affords	read	afford
7	line 6	totulity	——	totality
20	— 13	prostrate	——	prostate
31	10-23	pubis	——	pubes
32	— 12	do	——	do
60	— 23	system	——	systems
63	— 8	simuses	——	sinuses
96	— 8	Samson	——	Sanson
107	— 13	effects	——	effect
147	9-10	Filiæ	——	Tiliæ
161	— 2	impatient	——	patient
189	— 4	diognosis	——	diagnosis
223	— 8	hypogastrum	——	hypogastrium
271	— 8	a	——	an
281	— 3	inch and a quarter	——	three quarters of an inch

SKETCH

OF THE

URINARY APPARATUS.

In order to form a correct notion of the apparatus by which the urine is secreted, a knowledge of the nature and properties of this fluid is absolutely indispensable. It is as much a wonder, as a loss to science, that notwithstanding the importance of this knowledge, as clearly shewn in the useful inferences derived from the analysis and observations of Fourcroy and Vauquelin, Majendie, Marcet, Proust, Prout, and others, very little has been done of late to render it more perfect, if we except the experiments of Prevost, Dumas, and Mr.

Chevreul. There are no organs more wonderful in their operation than those which secrete the urine, and there is no animal product of a more interesting nature than this variable and compound liquid.

Such is the nature of urine, that life cannot be long sustained when its secretion is prevented: the elements of which it is composed *must* be constantly separated from the blood. And this will be easily conceived if we recollect its effects, when by any accident, it happens to be retained for a few hours, either in its natural reservoir, or elsewhere. Wherever it sojourns, even for a short space of time, it produces mortification in the parts with which it is in immediate contact, no matter of what structure, or vitality. There is scarcely any foreign substance, or poison, the presence of which is more inimical to living tissues. Every surgeon is well acquainted with the destructive properties of the urine, and can judge how incompatible with life must be the interruption of its secretion.

I have, myself, seen its infiltration produce death, in more instances than one, in less than twenty-four hours, and there are few who have not had to lament the inefficiency of art to counteract its disastrous effects.

The urine, then, is not only useless in itself, but of a highly destructive nature; and this remark appears to apply to the whole animal kingdom. It will be found, that wherever this fluid is employed at all, it is used only as a means of defence; and that, from its peculiarly offensive if not deleterious qualities.*

* Several of the weasel tribe have recourse to the expulsion of their urine, to check the pursuit of enemies; and the annoyance and species of suffocation occasioned by its strong and tenacious smell affords them no inefficient protection. The fox appears to rely upon the same expedient to stop the progress of its pursuers. That insect which the French call *le pistolet* owes its name to the report accompanying the ejection of its urine, which the creature seems to direct against external foes. The venom spit forth by the toad is nothing more, and the cuttle-fish foils the approach of aggression by troubling the water with its black urine, so as to be lost sight of by its followers. (Blainville, Leçons de Physiologie.)

The urine ejected in the morning, after sleep, is that preferred for experiment; because it is supposed to contain the greatest quantity of its essential materials, and consequently, to possess in the highest degree, its characteristic properties. Viewed with a microscope, it is a clear fluid, containing more or less mucous matter, which floats in it, and appears to be composed of globules not unlike those of the blood. Its smell, upon its first expulsion from the bladder, is not offensive; but such is its tendency to decomposition, that a change marked by the formation of ammonia and carbonate of ammonia, occurs as soon as it is in contact with the air; and there is every reason to believe this change is preparing, if it does not begin even, in the ureter and bladder, especially when it is retained too long. In almost every case it becomes acid soon after its expulsion, thus differing from all other animal fluids, which seem to be alcaline; whilst those of vegetables are acid.* The uric acid, which is generated probably

* Blainville

in a great measure by the decomposition of the urea, appears to be that most natural to the urine. But the best data concerning this fluid are furnished by its chemical analysis. Chemists, however, do not exactly agree about the nature and number of its elements; a fact strongly corroborative of the observations made by medical men, respecting its variable physical properties. According to Berzelius it contains,

Water	933.00
Urea	30.10
Uric or Lithic Acid	1.00
Mucus	0.32
Uncombined Lactic Acid, Lactate of Ammonia, Animal matter soluble in Alcohol, Insoluble animal matter, Inseparable urea,	1.417
Phosphate of Ammonia	1.65
Hydrochlorate of Ammonia	1.50
Phosphate of Lime and Magnesia	1.00
Sulphate of Potassa	3.81
Sulphate of Soda	3.16

Phosphate of Soda	2.94
Chloride of Sodium	4.45
Silica	0.03
Fluate of Lime	traces

Fourcroy and Vauquelin have found in it, in addition to these substances,—Phosphoric, benzoic, and acetic acid, hydrochlorate of potash, triple phosphate of soda and ammonia, triple phosphate of magnesia and ammonia, urate of ammonia, benzoate of ammonia, carbonate of ammonia, colouring matter, odorous matter, albumen and gelatine.

Proust detected in it, Sulphur, a particular black matter, carbonic acid, sub-carbonate and sulphate of lime. And Mr. Prout discovered a new red matter in it, which he has called rosacic acid.

The slightest attention to the composition of the urine will shew that its secretion may be well considered as a function of depuration, the great object of which, is, to

purge the blood without intermission of all the putrescent, and too animalised substances it contains. These, as we have already stated, must be constantly thrown out of the system, and they can escape in totality only by the urinary apparatus: no other can secrete a fluid exactly similar to the urine.

Although the principal materials of this fluid are found in all individuals, yet, it may be said to vary, as to the number and quantity of these, more than any other secreted in the body. In this point of view its study is of the greatest practical importance. Unfortunately, in the present state of science, we can appreciate only approximatively many of the circumstances upon which the quality and relative proportion of its elements depend; but there are others having a great influence, which we are well acquainted with, and can regulate and direct

The urine as it is distilled from the kidney differs considerably from that which is

contained in the bladder; not only, because it is unmixed with the liquids secreted in the latter organ, and is consequently less aqueous; but because, having from the unfixed nature and mode of combination of its elements, a strong tendency to decomposition, the very moment it is separated from the blood, it must be more and more changed by this tendency, in proportion to the time it remains in the body after being secreted. It is evident that there is more undecomposed urea, and less water and mucus in the urine of the kidney, than in that of the bladder. The urine varies somewhat according to age, sex, and temperament. That of females is more aqueous, and contains less of solid matter than that of men. In lymphatic habits it is apt to be very limpid; and bilious persons frequently void it tinged with the colouring matter of the bile. In cold, damp climates it is probably secreted in greater abundance than in a warm and dry atmosphere. But, the most direct and striking changes operated in the urine, are

those connected with the state of the different functions, and those produced by the substances taken into the stomach.

A certain quantity of matter must be separated from the blood by the different secreting organs; and whenever there is a deficiency of action in any one of these, nature endeavours to make it up, by exciting a proportionate increase of action in the others. Now, there is no set of organs more frequently called upon for this extra supply, than the urinary apparatus. Frequently, from the many various causes liable to interrupt the action of the common integument, what should be thrown off by the skin, is sent to be got rid of by the kidneys. When the liver is sluggish in the exercise of its functions, the kidneys are frequently obliged to do double duty, and to perform what cannot be long compatible with their healthy structure. If the secretion in the alimentary canal is less than it should be, that of the kidneys will be more than, and of a different nature to what

it ought to be. If the physiologist will but bear in mind these things, he will not be much at a loss to account for the formation of stone.

The influence of the aliment is still greater and more immediate, and consequently, of the highest importance in reference to disease. There is the most intimate relation between the substances taken into the stomach and the urine. If there be too much acid in the stomach, there will be too much in the urine; if too much alkali, too much alkali in the urine also, unless the power of the constitution be sufficient to counteract the prevalence of one or the other by a new combination; for, nature will attempt, and often successfully, to neutralize whatever may be in excess. In general, however, it will be found, that wherever there is much nitrogen in the food, there will be much urea and uric acid in the urine; and, thus have we a direct clue to the most common cause of urinary calculi. This point has been decided by direct experiment. Wol-

laston discovered, that when birds are fed exclusively on vegetable substances, the uric acid disappears from their urine, and, that when fed on animal substances only, their urine is almost entirely composed of it. Majendie repeated these experiments on dogs, and found, that by vegetable diet, their urine could be made to contain neither uric acid, nor phosphates; and that it became alkaline, instead of acid.* After this, it will not appear astonishing, that the specific gravity of the urine should vary, as it does, from 0.005 to 0.033. Happily, the effect of diet on the urine, and the organs secreting and containing it in the body, is immediate: every body knows how quickly its properties may be altered by turpentine and asparagus, the one imparting to it the smell of violets, the other rendering it very offensive. By attending to the analysis, we perceive, then, that water, urea, and salts give the urine its characteristic properties. A thousand parts of urine contain 933 parts

* I have obtained the same results from similar experiments.

of water, thirty parts of urea, and nineteen or twenty parts of various salts.

The quantity of water depends on that taken into the stomach and intestines; and the urea, which is one of the most animalized substances we are acquainted with, is in direct proportion to the quantity of animal food injested and digested, whilst the quantity of salts seems, also, to be in relation with the latter.

The fluids which are taken into the stomach, as drinks, and which are not converted into chyle, such as water, beer, wine, &c. are immediately absorbed and taken, in great part, with the blood, to the kidneys: these form the aqueous part of the urine. The chyle, which is also taken into the blood vessels, is thick, and rich, that is, contains more nitrogen, in proportion to the quantity of animal food furnishing it; and this it is, from which the urea and more solid part of the urine are derived.

There is, then, on the one hand, a strongly

animalized substance, that is, a matter containing a great quantity of nitrogen and having a great tendency to decomposition, called urea, which must be constantly separated from the blood, and the quantity of which depends on the quality of the chyle and blood.

On the other hand, we have the alimentary fluids, which are not susceptible of being converted into chyle, and which consist chiefly of water. Now, although there are several organs where these last mentioned liquids may be separated from the blood, the major part of them are evidently let off with the urea in the urinary apparatus; they unite with this substance to facilitate its complete, and safe evacuation. Hence, the necessity of their rapid transport from the alimentary canal to the urinary organs. They are taken up, (as the ingenious experiments of Majendie and Segalas have fully established) by the mesenteric veins; and, after circulating in the liver with the blood of these vessels, be-

come mixed with the general mass of the circulating medium, in the venæ canæ and right cavities of the heart. The urea is of such a nature, is so *azotized* a substance, and so difficultly separated from the body as to require a special apparatus; and the liquids alluded to, being aqueous and *non-azotized*, are, for the most part, employed to facilitate its escape. They are used as a means of dilution, without which, the chemical equilibrium, which obtains in the animal system cannot be long preserved.*

* Without exaggeration the discovery that the veins absorb these fluids may be considered almost as important as that of the circulation of the blood. It has strengthened the science of pathology and given to therapeutics a degree of certainty which our ordinary means of observation could never have afforded. Writers on dietetics should place it at the head of their works, as a main part of the basis upon which rules of diet are to be founded, and moralists might set it forth with advantage in recommending maxims of temperance.

Horace says,

"Vacuis committere venis,
Nil nisi lene decet."

and Shakspeare speaks of poison coursing,

"Through the natural gates and alleys of the body."

But it has never sufficiently come home to us, that the mixtures we take of sauces, wines, punch, &c. must run through the blood vessels, and be strained through the very tissue of our organs, before they can be expelled from the body.

With these data we may come to a rational definition of the urinary apparatus. It may be considered as a kind of filter for separating from the blood, certain substances, (more especially urea or the elements of urea,) which require, in order to preserve their fluid state, to be mixed with the *unanimalized* fluids taken up in the alimentary canal by the mesenteric veins.

Blood vessels are the essential elements in this apparatus; they are disposed so as to constitute two glands termed the kidneys, which are lodged behind the peritoneum, in the lumbar region of the abdomen.

The arteries ramify and anastomose with one another, and with the veins, without becoming excessively minute, and at last form a vascular tissue communicating with ducts,* into which the urine is strained by virtue of a chemical influence exercised

* A fine injection thrown into the renal artery will pass without difficulty into the uriniferous tubes.

upon the elements of the blood. The kidneys have the same structure in all animals, and are the principal or more essential parts of the apparatus. I use the terms, *more essential*, because the bladder is materially concerned in the urinary function, and ought not to be considered merely as a reservoir.

The artery of each kidney is not more than two inches and a half in length. It arises from the side of the abdominal aorta, and is so voluminous as to offer one third of the caliber of that great trunk. After ramifying and anastomosing with the veins, its finest terminations open into a multitude of minute ducts called the uriniferous tubes. (tubuli uriniferi.) The renal vein is even larger than the artery and not longer: it opens directly into the vena cava. The blood vessels occupy, more especially, the superficial parts of the kidneys, and the intervals between the uriniferous tubes. These last are assembled in groups, from twelve to eighteen in number, and run from

the external towards the internal edge of the kidneys, Each group may contain about a hundred tubes; and forms a cone, the summit of which is a small, rounded, free papilla, embraced in the pelvis or commencement of the ureter, by a little fold of membrane termed the calyx. The urine oozes from the papillæ, and can be squeezed out of the tubes composing them, as the milk may be expressed from the lactiferous ducts of the nipple. Disseminated upon these different orders of vessels, are lymphatics and nerves. The latter supply the kidneys with vitality, and being wholly furnished by the great sympathetic, render them perfectly independent of the will. The kidneys have the shape of a bean of that name; they are flattened from before backwards, and larger superiorly than at their lower part. When cut into, the part formed by the blood vessels may be easily distinguished, by its deeper red colour and granulous aspect, from that constituted by the ducts, which has a striated appearance.

The first is termed the cortical, the other the tubular substance.

The element of next importance to the blood vessels in the urinary organs, is the mucous membrane. It may be said to commence at, or to be continued from, the uriniferous tubes; increasing in thickness as it proceeds from these, it forms around the papillæ, the calices or cup-like investments, and then enlarges into a sort of pouch, which is the commencement of the canal for carrying the urine towards the exterior. This mucous canal descends to the pelvis, and there expands into a reservoir, the urinary bladder. Until it forms the bladder, the mucous membrane of this canal appears but as a secondary element; but here, it is well supplied with arteries, which probably serve, not only to nourish it, but to let off certain parts of the blood circulating in them. It is on this account, that the bladder, or at least its mucous membrane, should not be considered as mere accessory machinery; for, in addition to the

purpose of convenience, it is most likely an organ, wherein nature takes a further opportunity of mixing more of the *unanimalized* or watery part of the urine with its *animalized* part, the urea. Farther on, the mucous membrane becomes again a secondary constituent, forming the ultimate canal or spout for conveying the urine entirely out of the body. In addition to the portion of this membrane employed in common canals, the fibrous investment of the kidneys, certain tunics of the ureters and urethra, and the muscular coat of the bladder, may be considered as accessory parts.

The substance of the kidney is supported and kept together by a fibrous membrane, which is reflected upon the vessels at the fissure termed hilus, where they enter. This investment has some connexion with the whitish, slightly contractile membrane, forming the external tunic of the ureter, and which is, in some degree, instrumental in propelling the urine towards the bladder. This external tunic of the ureter is con-

tinuous with the muscular or contractile coat spread over the mucous bag of the bladder, for the purpose of expelling the urine.

At the floor of the bladder of the male subject, as will be described hereafter, the urinary and genital organs become blended; so that the urethra and certain muscles serve, as well for the transmission of the semen, as for the excretion of the urine. This union of the two sets of organs exists throughout nearly the whole animal kingdom. The prostrate in function belongs to the organs of generation nearly as much as the vesiculæ seminales; like them, it is an accessory part of that apparatus. But let it not be supposed that this junction of organs, as to situation, implies any thing like similarity of functions. No fluids differ more materially, than that secreted by the kidney, does from that produced by the testicle. Besides, these organs differ essentially in structure; and, if they are placed together, it is entirely for the purpose of

convenience. Nature having but a certain space, has employed it to the best advantage; notwithstanding the apparent inconsistency of transmitting the most useful and the most useless secretions, by the same canal.

The animalized part of the urine is secreted without intermission, and its aqueous part should also be produced constantly. Both, as we have seen, are in variable quantity, according to circumstances. When the apparatus is in perfect order; the urine, distilled as it were from the papillæ of the kidney, gradually spreads into the commencement of the ureter, and is then conveyed by this canal to the bladder. It is not, however, incessantly poured into this reservoir, but falls into it, drop by drop, at each inspiration. Its passage is effected by several forces. It first oozes from the kidney into the commencement of the ureters, by the action of the arteries. It then descends in consequence of the pressure exercised on every thing in the abdo-

men, during inspiration and expiration; by the contraction of the external tunic of the ureters; and, also, by an influence, which we are seldom in an attitude wholly to counteract, its own weight. Thus, supposing the two first inches of the ureter to contain ten grains of urine; this quantity will be acted upon by the above mentioned forces, during inspiration, and will descend. In passing down, it will dilate the next two inches of the canal, which will then, in their turn, contract, and be pressed upon during expiration; whilst the first two will be receiving a fresh quantity of the fluid. These successive contractions of the ureters being separated by no measurable interval, constitute a sort of vermicular motion, beginning as soon as a sufficient quantity of urine is received from the kidney. This quantity will be furnished, in all probability, during each inspiration, when breathing is slow; but the time must vary according to circumstances.

In a dog, it may be seen to fall into the

bladder in this way, a few grains at a time; the contraction of the inferior part of the ureter helping to force it into this organ at each inspiration, or thereabouts. It has also been observed to flow in this manner, in children affected with extrophia of the bladder; more particularly by Mr. Blandin.

The urine gradually accumulates in its reservoir, until it produces those peculiar sensations which urge us to its expulsion. As the bladder fills, its muscular coat is stimulated to contract by the pressure of the urine. If, however, the want be not obeyed, an irritation *sui generis* is occasioned in the nerves of the mucous membrane, and extends to the end of the urethra. After this warning, the urine should be voided; for, any further retention is contrary to the natural action of the organs; as will appear by a little attention to what occurs, if the call of nature be not answered. In this case, the nerves receiving and communicating these sensations, tire; that is, they cease to be susceptible of bearing

the impressions, which let us know when the bladder ought to be emptied, and which are, therefore, felt afterwards, only at long intervals. The urine continues to collect, and the peritoneal coat of the bladder being put upon the stretch, a feeling of weight, distention, and pain is experienced at the lower part of the abdomen. At the same time, the mucous membrane is acted upon in another way; namely, by the chemical changes going on in the urine. This fluid undergoes a commencement of decomposition, and assuming more acrid and poisonous qualities, determines by its contact, a serious inflammation of the mucous membrane. And, it is to be remarked, that although nature would fain hinder or lessen this effect, by determining a secretion to take place in the bladder; it cannot be done without increasing the distention of this organ; and, thus, her resource for preventing one kind of mischief is counterbalanced by becoming itself the cause of another.

The effect of these divers influences is

soon felt by the kidneys, whose action is thereby deranged, and, at last, interrupted to such a degree, that the elements of the urine are retained in the blood: and, although a tremendous effort is made to throw them off by the skin, they soon infect the whole body. The next steps are mortification and death.

The urine is expelled from the bladder, partly by the active contraction of this organ itself, and partly by accessory muscular power. The diaphragm and abdominal muscles first enter into action; and the bladder, being subjected by their contraction to a certain degree of pressure, is enabled to contract also. Its closed orifice is thus forced open, and the urine flows along the urethra. The current is afterwards maintained by the contraction of the bladder alone; except in the ejection of the last portions of urine; for which the abdominal muscles renew their assistance; whilst the bas fond is lifted up with the rectum by the levatores ani. Some of the

perinæal muscles lend their aid to expel the last drops from the urethra.

Thus, the ejection of the urine from the bladder is under the immediate influence of the will; the muscles chiefly concerned in it, being supplied with nerves from the spinal marrow. The contraction of the bladder itself, is, however, necessary; and, as this organ receives nerves, both from the spinal marrow and great sympathetic, its action is in close relation with both the voluntary and organic functions.

DESCRIPTION OF THE BLADDER

IN THE

ADULT MALE SUBJECT.

The bladder occupies the major part of the pelvis. It is situated below the convolutions of the small intestines, which roll on the back part of its summit; above the inferior half of the rectum, and some of the perinæum; behind a portion of this last and the symphysis pubis; and before the upper half of the rectum, by which it is separated from the hollow surface of the sacrum. Laterally, the bladder is bounded by the sides of the pelvis; but, in this direction there is ample room for its expansion.

The form and volume of the bladder vary considerably; and these are points, which, however unimportant they may appear at first sight, deserve great attention, and such an investigation as will leave a lasting impression on the mind of the surgeon. When filled, and somewhat distended, its vertical diameter is about five inches;* its antero-posterior diameter taken in the centre, about three inches, and its transverse diameter three inches and a half. In general, its form is oblong; its great diameter being nearly parallel to the upper half of the anterior region of the sacrum; it is rather of a conical shape, and more capacious by one third at its base than at its upper part.

The size of the bladder depends in no small degree upon the quantity of urine it

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* These dimensions must not be supposed to indicate the exact admeasurement of the bladder: they are given only with a view of pointing out more correctly its form and relations.

has been accustomed to contain. Those persons who are in the habit of retaining their urine long, have large bladders; the contrary is observed when this fluid is frequently voided. Deformities of the pelvis, the state and size of the rectum and neighbouring parts, necessarily modify the shape of the bladder.

The summit of the bladder is sometimes extraordinarily large; its lower and back region, which the French very properly call the bas fond is always capacious. Some of the varieties of shape the organ presents, may be explained by a difference of strength in different parts of its parietes, and the unequal resistance offered to its distention by surrounding parts.

We now come to the relative position of the bladder. It is, however, of extreme importance that the Surgeon should first know that it is a fixed organ, not a floating one. There is one part of it as immoveably fixed as any soft parts in the body; yet,

this fact seems to have escaped anatomists, or to have appeared to them either too evident or of too little consequence to demand particular notice. The bladder is fastened, at its neck, to the pelvis, nearly as strongly as tendons are to the bones into which they are inserted; and, in this respect, it differs materially from every other organ in the abdomen. Its anterior and inferior part is fixed by those strong fibrous fasciculi described by authors as the anterior ligaments of the bladder; by the triangular ligament of the urethra, which is continued along the membranous portion of the urethra with the capsule of the prostrate gland; and, indeed, by the whole of the strong fascia of the pelvis. I do not mean to affirm that these parts are as strong as tendons, or ligaments: but they certainly yield as little without laceration or injury; and as this is one of the most important facts connected with the treatment of stone, I particularly solicit attention to it.

The anterior region of the bladder corres-

ponds to the symphysis pubis; to the pubic ligament, from which it is separated by its own anterior ligament and cellular tissue; and, in a small extent, to the triangular ligament of the urethra. Above the symphysis, this region corresponds, opposite the linea alba, to the fascia transversalis of Sir. A. Cooper; but whenever the bladder rises fairly an inch and a half above the pubis, it is in contact with the peritonæum lining the wall of the abdomen, in addition to its own peritonæal covering. In other words; the shining surface of the peritonæal covering of the bladder is in contact with the same surface of the peritonæum lining the muscles of the abdomen; so that an instrument, to penetrate this part of the organ, must traverse the peritonæum twice.

I am induced to lay claim to the discovery of this fact; for, all the authors I have read, state, that when the bladder is distended so as to rise above the pubis, it passes to a considerable extent between the perito-

næum, and the abdominal muscles, or rather between it, and the fascia transversalis. I was led to this discovery, from having seen the peritonæum wounded in the high operation for stone, by the best operators; which I could not explain, till I observed, on investigating the subject, that when the bladder is distended by insufflation, it rises in the proper cavity of the peritonæum. I do not pretend that a small part of the bladder, thus distended, may not be uncovered by the peritonæum above the pubis; but I positively assert, that this organ, (and in old persons more especially,) expands in the abdomen, in some such manner as the uterus does in gestation, by a gradual yielding of its peritonæal as well as of its other coats; and not by detaching the peritonæum, as it has been hitherto supposed, from the abdominal parietes. It is remarkable that an acquaintance with the nature of serous membranes did not lead *a priori* to a knowledge of this fact. Why should not the serous membrane of the bladder yield as much as its mucous and muscular

coats; when it is well known, that the susceptibility to yield to distention, is one of the characteristic properties of serous membranes? Indeed, they yield more promptly than other membranes, as we see in hydarthrus, hernia, ascites, and in a multitude of other circumstances.

I need not insist more upon the importance of this anatomical disposition, particularly as it will be necessary to return to the subject hereafter; but, it explains at once the error committed by lithotomists, who, in laying open the bladder above the pubes, to their great consternation and surprise, have found their fingers or instruments in the cavity of the abdomen.

The vertical extent of the anterior region of the bladder, from its summit to the upper part or wall of the urethra is about three inches and a half; its breadth is about two inches and a half.

The posterior region of the bladder cor-

responds to the upper half of the rectum. There is, between these organs, a peritonæal space, cul de sac, or vacuity, varying in extent according to their state of plenitude, which may be occupied to a certain degree by the floating intestines. This cavity is more marked on the sides of the rectum, where the large vessels and nerves of the pelvis lie, than at its centre. The extent of this region in the vertical direction is much more considerable than the anterior; because it descends in the cavity of the pelvis as far as the floor formed by the inferior part of the rectum; it is generally five inches and a half. The breadth of this region also exceeds that of the anterior region; as this last contracts inferiorly, to form a part of the neck of the bladder.

The lateral regions of the bladder, the extent of which may be now easily conceived, are narrow superiorly, and broad below, where they are strongly embraced by the fascia of the pelvis, and have some relation to the ureters, vasa deferentia, and umbilical arteries.

The summit of the bladder, covered by its peritonæal coat, rises, as we have pointed out, in the cavity of the peritonæum; and not between this membrane and the wall of the abdomen, where a small part of its anterior region only may be found.

The inferior region of the bladder lies obliquely at the anterior part of the inferior aperture of the pelvis; it is neither parallel to the bones circumscribing this aperture, nor to the cutaneous surface of the perinæum. Its most posterior part lies deep, to allow that part of the rectum which forms the anus, to advance; while its anterior part is, in general, three quarters of an inch nearer the surface. This region has been very naturally divided into two parts, the prostatic portion, and that which the French call the bas fond. It is necessary to explain, first, what is meant by the prostatic part of the bladder; for, anatomists generally describe the prostate as a separate part. Now the prostate is a distinct, but not a separate part; it can be no more se-

parated from the bladder by dissection, or even by maceration, than the glans penis from the urethra. It forms, in reality, a portion of the bladder; and it is from being placed as a kind of soldering tissue to join this reservoir to the urethra, that it has been considered a component part of both.

The prostate rises laterally, so as to constitute, not only the floor, but also a portion of the sides of the neck of the bladder; which neck is completed by the junction of the inferior, anterior and lateral regions of the organ. This prostatic part of the inferior region of the bladder lies upon, or rather corresponds to, the triangular ligament of the urethra, from which it is separated only by some cellular tissue, and muscular fibres belonging to the levatores ani. Its posterior part or margin lies immediately upon the rectum. In this description the prostate is considered covered by the strong fascia which forms its capsule.

The posterior portion of the inferior region of the bladder, or the bas fond, is the real bottom, basis, or most depending part of the organ. It lies upon the rectum, closely connected with it by the dense cellular tissue or fascia of the pelvis; except laterally, and before, where these organs are separated by the vesiculæ seminales, themselves intimately united to the bladder by this same tissue which every where serves to fix it to the pelvis. The extent of the whole of the lower region of the bladder from before backwards, may be measured by a line drawn from a point one inch and a half below the inferior part of the symphysis pubis, to the junction of the upper with the lower half of the rectum. It will be found in general to be about three inches and a quarter, but will vary according to the state of the rectum, the anterior wall of the intestine forming the moveable platform, upon which the back part of this region reposes.

The transverse diameter of this region, taken in its middle part, is about two inches and a half; behind this centre it bulges out to form the bas fond, and anteriorly to it contracts, to constitute the inferior conical floor of the neck of the bladder.

OF THE

URETHRA CONSIDERED IN RESPECT

TO ITS

DIMENSIONS, FORM, AND RELATIONS.

The urethra is the excretory duct which conveys the urine from the bladder out of the body. Its length, adapted to that of the penis, varies somewhat in different individuals; its general caliber is seldom more than one third of an inch, and often a little less, but it varies in different parts of its extent. From the point of the prostate to just beyond the triangular ligament (the membranous portion,) it is smaller and less dilatable than at any other part. At the bulb, it is rather more capacious, and from

this to the glans penis it preserves an uniform diameter. At the latter part, it enlarges a little, constituting the fossa navicularis, and finally contracts at its external orifice, which represents a vertical fissure. It is impossible to mark the precise point at which the bladder terminates and this canal begins, any more than to point out the place of junction between the neck and body of a common bottle. We may, however, consider that the urethra commences at the anterior angle of the prostate, and terminates by its external orifice at the extremity of the penis. Anatomists commonly describe the urethra as traversing the prostate without telling us where it begins; and they divide it into a prostatic, a membranous and a spongy portion; the first corresponding to the prostate, the second extending from this to the bulb, and the last from the bulb to its external orifice: hence the difficulty to comprehend the description of the different operations performed in these parts, and the ambiguity and want of precision so well suited

to puzzle and perplex the anatomical student. I have frequently been asked by men of talent and experience, what the distinction is between the prostate, the urethra, and the neck of the bladder. They could not understand, if the urethra passed through the prostate, as described by anatomists, how it was, that lithotomists were said to carry their incisions from the end of the urethra into the neck of the bladder.

The conversation would run thus.—

Q. Where does the urethra commence?

A. At the neck of the bladder.

Q. What is the neck of the bladder?

A. That part corresponding to the prostate.

Q. Well; but the urethra traverses the prostate; therefore it must commence beyond it, at the body of the bladder.

Here it has been necessary to state what I have just explained, and to shew, that the confusion was owing to the indefinite and vague limits assigned to these parts.

The neck of the urinary reservoir is formed inferiorly, and in some measure, laterally, by the prostate; and in the rest of its extent, it is completed by the anterior and lateral walls of the bladder converging at the anterior extremity of the prostate, where, in my opinion, the urethra should be made to commence. To ascertain the propriety of adopting these limits, it is only necessary to open a bladder *in situ*, from the summit to about the middle of its posterior wall; it will then appear evident, that the orifice of the neck of the bladder is at the anterior extremity of the prostate; that the prostate forms the whole floor and a portion of the sides of the neck, and that all behind this gland belongs to the body of the organ. Therefore, in the lateral operation for stone, the only part of the neck interested, is that which is constituted by the prostate; if the incision be carried beyond the prostate, it is the body of the organ which is cut. The opening should be described as made in the membranous portion of the urethra and pros-

tate; that is, in the commencement of the urethra and that part of the neck of the bladder which is formed by the prostate. To divide any other part of the neck would require to cut upwards, or obliquely upwards, above the prostate, a thing never dreamt of in the lateral operation.

The urethra begins, then, at the anterior extremity of the prostate, and immediately traverses the triangular ligament, or septum perinæi, passing through which, it may be said to emerge from the pelvis. It is then united to the sheath of the corpora cavernosa under which it lies, and the extremity of which it completes by the expansion of its erectile tunic, the dilated part which is called the glans penis, serving as a sort of capping to them. Firmly united to this sheath, it is adapted to the form of the penis with which it is moveable beyond the triangular ligament; but at this last point it is immoveably fixed. To determine the precise situation of that part of the urethra which is fixed or attached to the bones of the pel-

vis is of extreme importance; because it is the proper and invariable guide to the neck of the bladder; and no one can pass a catheter into this organ, with safety, unless he be well acquainted with its position. This part of the canal lies one inch and a quarter below the inferior part of the symphysis pubis, about three quarters of an inch under the lower edge of the pubic ligament.

Behind the triangular ligament, the upper part of the urethra corresponds to that portion of the fascia of the pelvis, which constitutes the anterior ligaments of the bladder; its under part or inferior wall to a few muscular fibres;* on each side of it there are veins. After its passage through the ligament, it is covered below by the bulbo-cavernosi muscles, a fascia-form cellular tissue, and the skin.

It has long been a question in dispute

* These fibres are known as Wilson's muscles; they belong to the levatores ani.

whether the urethra is straight; and authors do not agree better about its direction; hence the difference of opinion respecting the form of catheters, and the variety of rules for introducing them. The urethra is, strictly speaking, a straight canal; that is, when detached from the penis and stretched in the direction of a line which would be a continuation of that of the inner surface of the basis or inferior region of the bladder. Now, although from its connexion with the penis it cannot in all individuals and at all times be made perfectly straight, the penis, which must be extended with it, not yielding sufficiently; yet, it may be drawn out so as to admit of the introduction of a straight instrument, which, when in the bladder in its natural position, will have precisely the direction of a line drawn from the inner surface or posterior edge of the trigonal space to the hole in the triangular ligament, and continued forwards. This line will be nearly parallel to the axis of the superior aperture of the pelvis. It is solely on account of the difference in length and elasticity between the urethra and

penis that the canal can be better stretched in most cases, on a curved than on a straight catheter. But the curved instrument is not preferred merely for this reason: it has the advantage, when introduced into the bladder, of occupying its centre; whereas, the end of the straight one cannot be carried from the bottom of the organ, without considerable pressure on the upper part of its neck, and on the lower part of the edge of the foramen in the triangular ligament.

A straight sound, when an effort is made to direct its end towards the centre of the bladder, represents a lever, the fulcrum of which is the lower margin of the opening in the triangular ligament, the resistance, the upper or rather anterior wall of the neck of the bladder, and the power the hand of the operator.

With a curved instrument the whole of the bladder may be explored; its summit may be reached without difficulty: this is quite impossible with a straight staff.

ORGANISATION OF THE BLADDER

AND

ITS EXCRETORY DUCT.

Considered in a general point of view, the bladder, like the alimentary canal, is formed of three distinct coats, besides layers of cellular tissue; a mucous membrane forms its internal, a serous membrane its external tunic, and between these is a membraniform stratum of muscular fibres. Its serous covering is furnished by the peritonæum, which passes from the anterior wall of the abdomen over the summit of the bladder, and then, lining its posterior surface, lateral regions and bas-fond, is reflected upon the rectum and sides of the pelvis.

By this reflection of the peritonæum from the bladder to the rectum, the inferior part of the pelvis is closed, and a sort of pouch or cul de sac is formed between these organs.

The middle part of this pouch advances within half an inch of the posterior margin of the prostate; whilst it recedes laterally, so as scarcely to cover the posterior extremities of the vesiculæ seminales. By this disposition, the most depending part of the peritonæal reflection represents a quick curve, its convexity being turned forwards, towards the prostate. The peritonæum is not constantly reflected at the same distance from the prostate; in some subjects it does not come within an inch and a quarter of it; in others it advances as far as its posterior margin. We see, then, that the inferior part of the anterior and lateral regions of the bladder, as well as the anterior part of its inferior region, have no serous coat or peritonæal covering. The serous coat of the bladder, is pretty intimately united to

the muscular coat, by a layer of cellular tissue which might be described as a distinct tunic. Its adhesion becomes weaker near the different points where it is reflected.

This cellular stratum which unites the serous membrane to the muscular fibres, may be considered as a modified continuation of the fascia of the pelvis, reflecting itself from the levatores ani muscles, under the peritonæum. The fascia of the pelvis is strongly marked, thick and dense, where it begins to be thus reflected, forming a strong floor or partition between the abdomen and perinæum.

Under this cellular tunic is the muscular coat, composed of fibres running generally in a direction parallel to the great axis of the bladder, some of which, however, are seen to cross each other.

These fibres muster in considerable strength at the bottom and neck of the bladder, where they intersect those of the leva-

tores ani muscles. A fasciculus of these fibres surrounds the neck of the bladder, so as to form a sort of sphincter; but this disposition is not very evident in some individuals. The muscular coat of the bladder, during its contraction, draws the moveable parts of the organ towards the fixed ones, exactly as the fingers spread over a bladder of elastic gum act, when pressure is made to empty it.

In individuals who have no very distinct sphincter vesicæ, the urine does not flow involuntarily: because, in the natural state, the vesical orifice of the urethra is closed, as we have already explained; and the contraction of the muscular coat of the bladder and of the abdominal muscles is required to overcome the resistance, which the closed urethra thus passively makes to the discharge of this fluid.

The sphincter of the bladder is by no means so necessary as that of the rectum; and in paraplegia, where there is involun-

tary evacuation of the fæces, the concomitant retention of urine is to be partly explained by this fact, that the contraction of the bladder itself is necessary to overcome the resistance of its naturally closed orifice.

The muscular coat of the bladder is sometimes so constructed as to form round fasciculi or pillars within the cavity of the organ, dividing it into cells, which may lodge gravel or calculi. These cells result from the unequal distribution of the muscular fibres. When these are collected in bundles, instead of forming a uniform stratum; the bladder, being consequently weak in the intervals which they leave, is there distended into cells. Such bladders are peculiarly favourable to the precipitation of substances contained in the urine; and when any concretion exists, it is liable to lodge in the cells, and is not so likely to be expelled as when the bladder is smooth. I have very frequently found calculi lodged in these cells, and sometimes have seen

the calcareous phosphate in a softish state, in great abundance, in all the vacuities between the columns.

The mucous coat of the bladder is thin and pale; its villi are so fine as to be scarcely discernible, and its follicles are not visible in the healthy state. It is of course continuous with the internal membrane of the ureters and urethra. Between the two last mentioned coats exists a dense but thin layer of cellular tissue, in which small ramifications of vessels and nerves are observed, and which has been described by some authors as the cellular coat of the bladder.

The fixed parts of the bladder offer peculiarities of structure, which require a separate description. They are the strongest and thickest parts of the organ of which they form the floor.

The prostate forms about the two anterior fifths of this floor or inferior region of the bladder. It is of a triangular form, its

base being turned backwards, its summit forwards. Its antero-posterior diameter is about one inch and an eighth; its base, measured across, has nearly the same extent. It is about three quarters of an inch thick; but the volume of the prostate varies almost as much as that of the spleen: in some subjects it has thrice the size here represented. It forms, as we have already stated, the bottom and a portion of the sides of the neck of the bladder, and joins it to the commencement of the urethra; its centre being slightly hollowed out for this purpose. Its internal surface is lined by the mucous membrane of the bladder, as it becomes continuous with that of the urethra; and, externally, it is intimately united to a layer of the fascia of the pelvis, which forms its capsule. From its shape, the prostate appears to be composed of two lateral lobes united by a middle and inferior portion; from the back part of this last a protuberance rises towards the cavity of the bladder, which produces an elevation of the mucous membrane, varying in form

and size, called the *uvula vesicæ* or luette vesicale. This protuberance corresponds to what has been called the third lobe of the prostate; it has sometimes been seen so developed, as to block up the entrance to the bladder. Anteriorly to this elevation, and corresponding to the anterior half of the prostate, is a ridge or elevation formed by a longitudinal fold of the mucous membrane.* At the anterior extremity of this, are the orifices of the ejaculatory ducts, separated only by the thickness of the fold, on the very tip of which, is another orifice, that of a long lacuna directed backwards. The precise nature of the tissue of the prostate is not known; it is firm and dense, almost as hard as fibro-cartilage; it contains a multitude of follicles, which open by twelve or fifteen small ducts upon the mucous membrane, near the verumontanum, where they shed a viscid fluid, of a grey or yellow colour. By pressure this fluid is seen to issue from the ducts.

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* The verumontanum or caput gallinaginis.

The two ejaculatory ducts pass through the prostate in a longitudinal direction, on the median line, at the distance of two or three lines from its inner surface. It is important to notice that these ducts, which are very small, run close together, and open into the urethra, each by a small orifice, upon the anterior and lateral parts of the verumontanum. They are formed of a mucous coat strengthened by cellular tissue.

Of the three posterior fifths of the basis or inferior region of the bladder, the anterior half has been called the *trigonal space* or *trigone vesicale*. This space is smooth and triangular; its posterior angles are formed by the orifices of the ureters, the anterior one by the uvula vesicæ, its sides being about an inch in length. The thickness of the bladder exceeds two lines in this place, under which are the vesiculæ seminales, separating its lateral parts from the rectum.

The orifices of the ureters, which form the posterior angles of this space, are not

easily perceived on the internal surface of the bladder; as these canals run obliquely between its muscular and mucous coats, for the extent of one inch. From their direction being almost parallel to the sides of the bladder, the mucous membrane forms over their orifices a sort of valve, which is an obstacle to the retrogression of the urine. Some of the fibres of the muscular coat are so disposed as to appear to have a certain influence, during their contraction, in closing these orifices.

The orifices of the ureters lie just above the posterior extremities of the vesiculæ seminales of which it may be necessary to give a brief description.

The vesiculæ seminales are placed, then, under the sides of the trigonal space of the basis of the bladder, upon the rectum; between the orifices of the ureters which are behind, and the prostate gland which is before them; on the outside of the vasa deferentia, and on the inside of the levatores

ani muscles. They belong to the genital apparatus by their functions, but, by their connexions they are not independent of the urinary apparatus, being firmly and intimately united to the bladder by a layer of the fascia of the pelvis ; yet they do not, like the prostate, form a part of this reservoir: they are united to the rectum in a much less intimate manner. Their length is about two inches and a half, their breadth rather more than half an inch, and their thickness about two lines. They are flat, slightly conical, and at their surface tubercular. Their anterior extremities, lying close to the slightly concave margin of the prostate, are separated only by the vasa deferentia ; whilst their posterior or free extremities are separated, by the distance of one inch and a quarter. They, therefore, circumscribe an external trigonal or triangular space, which lies immediately upon the rectum.

The vesiculæ seminales seem formed by a continuation of the vasa deferentia dis-

posed as a flexuous canal, wound up, and having its divers flexures united, so as not to be easily unfolded; at any rate, the vasa deferentia, vesiculæ seminales and ejaculatory canals, are inseparably united at the posterior edge of the prostate. When cut through, they appear divided into cells, which are separated by partitions. They are formed of an external white coat, analogous to, but somewhat finer than, that which forms the vasa deferentia, and of an internal mucous lining not unlike that of the gall-bladder. They are abundantly supplied with blood vessels. The vasa deferentia lie close to the inside of the vesiculæ seminales; they are here larger and more flat than in the rest of their extent. Following these vasa backwards, we perceive that they pass towards the lateral regions of the bladder, superiorly and anteriorly to the ureters and behind the umbilical arteries.

In addition to these peculiarities of structure, in the fixed parts of the bladder, one remark may be applied to its summit or

most moveable region. This part of the organ is of considerable thickness, the muscular fibres being assembled in it in a strong cluster. The urachus, a fibrous cord or obliterated canal, and, on the sides of this, the umbilical arteries, all ascending between the peritonæum and linea alba to the umbilicus, tend to increase the substance of the summit of the bladder.

The bladder has a large supply of blood; the number and volume of its vessels, however, vary considerably. They occupy its lower and lateral regions principally. The arteries spring, three or four of them, from the umbilical, one or two from the hemorrhoidales mediæ, some from the internal pudic, and one from the trunk of the hypogastric. This last, called by Chaussier the vesico prostatic artery, is small; it runs along the bottom of the bladder to the prostate, spreading its branches in this gland, in the vesiculæ seminales and rectum.

The obturator and epigastric arteries,

give a few twigs to the upper part of the bladder.

The veins correspond to these arteries; but there is, besides, a very important plexus on each side of the neck of the bladder, situated, in general, immediately above the prostate and vesiculæ seminales. It is formed by most of the veins of the penis, which pass under the arch of the pubes, and after dividing, sub-dividing and anastomosing with the veins of the bladder to form it, collect into two or three trunks, that open into the internal iliac, near the obturator. This plexus merits the particular attention of the surgeon; it should be respected in all operations; for there is no part, the lesion of which is more serious.

Its inflammation is generally followed by suppuration and death, and when wounded, it is a source of troublesome and sometimes fatal hemorrhage. The nerves of the bladder arise from the spinal and great sympathetic system; several filaments proceed

from the sacral, and many from the hypogastric plexus. They vary in number, and are irregularly interlaced; passing over the sides of the rectum, they arrive at the lateral parts of the basis of the organ, to the mucous and muscular membranes of which they are distributed, as well as to the prostate gland, and vesiculæ seminales.

The lymphatics of the bladder proceed to the hypogastric glands, and more especially to those placed on the passage of the umbilical arteries.

ORGANISATION OF THE URETHRA.

The urethra is formed of an internal mucous membrane, a dense cellular coat, and a peculiar erectile tissue. Its mucous membrane is continuous with the integument of the glans penis on the one hand, and with the internal lining of the bladder, of the ejaculatory and prostatic ducts, on the other. It is of a pink or red colour, near the former, and whitish in the rest of its extent. Where the mucous membrane lines the anterior half of the prostate, it offers, as we have already stated, the longi-

tudinal rising called the *verumontanum*, with the orifices of the ejaculatory ducts, and of a lacuna three quarters of an inch in length. On either side of this elevation the prostatic ducts are generally observed to open; anteriorly to the bulb of the urethra, it presents numerous other lacunæ, called the simuses of Morgagni; they are little canals formed by the reflection of the membrane, which is throughout very fine and delicate; and they become more and more abundant towards the fossa navicularis.

The cellular coat of the urethra is almost inseparably united to its mucous lining; it is blended with the tissue of the prostate, and from this gland to the bulb, an extent of three quarters of an inch, comprehending what is called the membranous portion of the canal, is peculiarly strong; being fortified by a layer of the triangular ligament and fibres of the surrounding muscles. In the rest of its extent, it is pretty intimately united to the erectile tunic.

This last coat constitutes a part of the urethra, from the triangular ligament to its external orifice. It begins by forming what is called the bulb; and then constitutes a uniform tunic as far as the glans penis. It is impossible to assign very definite limits to the bulb of the urethra; by which I understand that part of the tunic, which lies upon the anterior surface of the triangular ligament, and which ceases to be bulb, when it adapts itself to the other coats of the urethra. Now, the extent to which it covers this surface of the ligament varies much: in some individuals it descends almost as far as the sphincter ani; in others, it does not cover more than four or five lines of this septum, to which it very closely adheres. This part of the urethra is covered below by the bulbo-cavernosi muscles, which, when they contract, press it against the triangular ligament. At the end of the corpora cavernosa the erectile tunic expands above and behind, to form the end, or glans penis, being at its under part, or below the fossa navicularis, very thin.

Its external surface is united to the corpora cavernosa by a layer of fibro-cellular tissue; and by a layer less firm and dense, to the bulbo-cavernosi muscles and to the cellular tissue, which separates it from the integuments of the scrotum and penis. It is constituted by erectile tissue, the cells of which are much smaller and more delicate than those of the corpora cavernosa penis, and contains no muscular fibres, other than those entering into the composition of the veins of which this tissue is formed.*

On the sides of the bulb, in the immediate vicinity of the triangular ligament, lie two little, round, glandular bodies, about the size of a pea, of a reddish colour and of a tissue not unlike that of the salivary

* The veins have all a contractile or muscular tunic; and as the erectile tissue is formed of veins, the urethra may be said to be muscular. I have examined this canal over and over again, with the most willing desire to detect other muscular fibres, but have never been able to discover any. I must say, however, that according to my own observation, the muscular coat of veins composing the erectile tissue generally, is more developed than in other veins; and the uses of this tissue seem to confirm the opinion I entertain of its structure.

glands: they open into the urethra, each by a small duct, three quarters of an inch in length, which runs obliquely forward to the mucous surface of the canal. These glands, which appear to be formed of an assemblage of follicles, are not always found.

It may be necessary to repeat, that the portion of the urethra between the anterior angle of the prostate and the anterior surface of the triangular ligament, a portion which never exceeds three quarters of an inch in length, is the fixed part of the canal; it lies under the arch of the pubis, one inch and a quarter below its symphysis, and is embraced by the opening in this ligament. This anatomists call the membranous portion.

The blood vessels of the urethra are furnished by the internal pudic; several twigs traverse the sheath of the corpora cavernosa to be distributed to it. Its lymphatic vessels go to the glands of the groin and pelvis. It receives nerves from the pudic and lesser sciatic.

DESCRIPTION

OF THE REGIONS OF THE BODY,

OR

PARTS, THROUGH WHICH, THE BLADDER MAY BE ATTACKED.

Having described the bladder and urethra, we have now to consider them as complete organs, in reference to the parts through which they may be laid open; and as the former can be attacked at the superior or at the inferior aperture of the pelvis, it is of great importance to form a correct notion of its position relatively to this osseous cavity.

The direction in which any thing can be carried into, or extracted from, the bladder,

with safety, depends upon an accurate knowledge of the relation the organ bears to the apertures of the pelvis. In fact, this relation should not be lost sight of for one instant, in any stage of any operation where the parts contained in the pelvis are concerned.

The cavity of the pelvis is thrown back so that its upper aperture is inclined forwards. In the erect posture, a horizontal line carried backwards from the symphysis pubis, falls in the middle of the hollow of the sacrum ; and another, perpendicular to this, carried from the same point upwards, meets the third lumbar vertebra.

The two apertures of the pelvis are by no means parallel; two lines directed from the surface of the body to the centre of of the cavity, one perpendicular to the plane of its superior, the other to that of its inferior aperture, must have very different directions.

The axis of the superior aperture is re-

presented by a line drawn from the junction of the two superior thirds of the sacrum with its inferior third, to the umbilicus; and the plane of the lower aperture is such, that its axis corresponds to a line drawn from the middle of the space between the apex of the coccyx and the symphysis pubis, to the sacro-vertebral prominence.

If the bladder occupied the centre of the pelvis, it would be right, in the extraction of a foreign body from its cavity, to direct the forceps in a line parallel, or as near as may be parallel, to the axes of the apertures of the pelvis: to that of the superior aperture, when the operation is performed above the pubes; and to that of the inferior aperture in lithotomy by the perinæum.

But, as this is not the case, a line drawn from the centre of the floor of the bladder to the most spacious part of either aperture of the pelvis, indicates the passage, which, as far as is compatible with the situation of the incision, ought to be given to a foreign body drawn from the bladder.

It is evident, that the more we deviate from this rule, the greater must be the compression and contusion of the soft parts, between the stone and the bones. And, yet, how very few operators are aware of this simple fact. We have all seen, and we every day see them sin in this particular; not unfrequently, patients are absolutely lifted up by instruments drawn against some part of the pelvis.

It has been usual to cut into the anterior region of the bladder, above the pubes; and to open its inferior region, by the inferior aperture of the pelvis, either through the perinæum or through the rectum, or by dividing parts of both. We have, therefore, to examine the supra and infra-pubic regions, in order to know what parts exist there, between the bladder and the surface of the body.

The anatomy of the first region is simply that of the lower part of the anterior wall of the abdomen; we must, however,

premise, that the different parts divided here to expose the bladder, must be cut through or traversed, in a direction parallel to the axis of the superior aperture of the pelvis, as close to the ossa pubis as possible. These parts are the skin, cellular tissue, the fascia superficialis, the linea alba, deep cellular tissue, and the fascia transversalis.

I have already explained that if this region were examined to the extent of one inch, above the pubes, it would be necessary to add to the parts just enumerated, two layers of peritonæum; namely, one layer covering the wall of the abdomen, the other forming the external tunic of the bladder. I have, therefore, purposely used the expression close to the pubes; meaning, that the instrument employed to open the bladder, should be kept in immediate contact with the superior surface of the symphysis.

The parts lie in the order, in which they are here named. The skin is covered with

more or less hair; the sub-cutaneous cellular and adipose tissue varies in quantity in different subjects; in some, its thickness does not exceed three or four lines; in others, it is one, two or three inches thick. The fascia superficialis varies, also, in strength and thickness, in different individuals. It is not very intimately united to the parts beneath it.

The linea alba, formed by the conjoined aponeuroses of the large muscles of the abdomen, between the adjacent edges of the recti and pyramidales muscles, is, in point of breadth, a mere line, at this part of the abdomen; so that, when cut through longitudinally, the margins of the above muscles of one side, seem to be in contact with those of the other. The deep cellular tissue intermediate to the linea alba and fascia transversalis, is not very abundant; that between the fascia and peritonæum constitutes a loose layer, containing more or less fat, and through which, unfortunately, the urine easily makes way into the

cellular tissue of the pelvis, after the high operation for stone. It is in this tissue that the part of the bladder lies, which we consider to be uncovered by peritonæum, namely, a portion of its anterior region, and not its summit.

The femoral artery furnishes the superficial epigastric, circumflexa ilii and sometimes other small branches to the skin, superficial cellular tissue and fascia superficialis; the deeper parts receive small twigs from the obturator and epigastric arteries.

We now proceed to the description of the infra-pubic region. Here, the extent of the inferior aperture of the pelvis is the first thing to be attended to, the boundaries of this aperture being, also, those of the infra-pubic region; to enquire how the opening is filled up, is, of course, to enquire what parts occupy, and in what manner, the perinæum and region of the anus. It cannot be too often repeated, that the dimensions of the outlet of the pelvis

are of the greatest consequence to the surgeon; they constitute a most essential part of the data, from which he is to decide as to the best treatment of stone; and, although they do not seem to have been considered of so much importance by anatomists, or even by those who have written *ex professo* on this disease, there can be no doubt that a person to whom they are not familiar, is utterly incompetent to form a correct opinion upon the subject. In general, the attention has been so little fixed upon the point in question, that, in the history of operations for stone, the extraneous body (somewhat increased in the eyes of the operator by the difficulty experienced in its extraction,) has been sometimes described of such a volume, as to exceed the extent of the osseous canal, through which it was made to pass; mistatements arising evidently from the errors abroad respecting the extent of the pelvic outlet.

The margin of the inferior aperture of the pelvis is formed superiorly and ante-

riorly by the symphysis pubis; laterally, by the branches of the ossa pubis and of the ischia; behind, by the summit of the coccyx; and on the sides, posteriorly, by the sacro-sciatic ligaments and ischiatic tuberosities. The plane of the aperture is inclined forwards, as its axis indicates.

The best mode of measuring the opening, and of appreciating its form and direction, is to remove the bladder, rectum, and all the soft parts of the perinæum and pelvis, except the obturators and pyriformes muscles, and their fasciæ. It will then be seen, that the distance from the bottom of the symphysis pubis to the tip of the coccyx, is about four inches and an eighth. The greatest transverse diameter is that taken from the back part of one tuber ischii, where the larger sacro-sciatic ligament is attached, to the same point of the opposite side; it passes immediately behind the anus and measures three inches.*

* The direction in which a stone should be extracted by the pelvic outlet is indicated by a line drawn from the incision

The extent of a line drawn across, along the inferior edge of the pubic ligament, from one side of the pubic arch to the other, is one inch and an eighth; lower down, opposite the posterior margin of the prostate, (and by opposite, I mean in a line intersecting another drawn parallel to the axis of the outlet, from this margin forwards,) the distance across, which has been tremendously over-rated, is only one inch and three quarters. Finally, the extent of a line drawn from one ramus ischii to the other immediately in front of the anus, is two inches and a half. This last line circumscribes what is generally called the perinæum; all that is posterior to it belonging to the region of the anus.

The length of one side of the pubic arch, taken from the back part of the tuber ischii to the bottom of the symphysis pubis, is about three inches and a half.

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in the prostate, towards the part of the pelvis, where this diameter is taken; but, as the prostate is turned forwards and near the bones, the extraneous body and blades of the forceps must first be made to revolve on an axis formed at the posterior extremity of the incision in this gland.

We have given the average admeasurement, but these dimensions vary much more in the male than in the female pelvis; and almost always, what is lost in one diameter is gained in another; if the distance is augmented from the symphysis pubis to the coccyx, the transverse diameter will be found proportionably diminished; and when the latter is excessive, the antero-posterior diameter is lessened.

At some depth in this space, towards the pelvic cavity, and fixed principally by the fascia of the pelvis, lie, on the median line, the floor of the neck of the bladder, or inferior surface of the prostate, and a part of the rectum. The only portion of this space on the median line left unoccupied by these parts of the bladder and rectum, is that between the symphysis pubis and anterior extremity of the prostate; it measures one inch and a quarter. The posterior margin of the prostate rests upon, and is in immediate contact with, the anterior wall of the rectum.

In examining, then, the middle part of the pelvic outlet, from before backwards, in which direction it measures four inches and an eighth, we have first the space of one inch and a quarter between the symphysis pubis and anterior extremity of the prostate, then we have the inferior surface of this gland, which occupies an inch and an eighth, and finally we have the remaining inch and three quarters occupied by the last curvature of the rectum.

To know the precise situation of the neck of the bladder and this part of the rectum, and to know what parts surround, and exist between them and the skin, is to be acquainted with the anatomy of the perinæum and region of the anus. The floor of the neck of the bladder, having its anterior extremity an inch and a quarter below the symphysis pubis, and its back part upon the rectum, is, we repeat, neither parallel to the skin, nor to the plane of the pubic arch. Its central part lies about an inch within this plane or from the perinæal surface of the ossa pu-

bis and ischia. Its anterior part is nearer the skin of the perinæum than its back part by at least three quarters of an inch; so that the thickness of the parts separating this region of the bladder from the skin, or the depth of the perinæum, which in its centre varies from two to four inches, is three quarters of an inch less anteriorly where the urethra begins, than posteriorly opposite the back margin of the prostate. Two distinct fasciæ, a good deal of cellular tissue and several vessels and nerves form the substance of the perinæum and separate the neck of the bladder from the common integument.

Under the skin furnished with hair and presenting a longitudinal line called the raphe that runs centrally from the rectum to the scrotum, we find a good deal of cellular and adipose tissue which is sometimes condensed into a strong fascia-form layer.

Beneath this, is a fascia extending across the whole perinæum and firmly attached

to the rami of the ossa pubis and of the ischia, where it meets the insertion of the fascia lata. It is very strong at its attachments to these bones, and thinner near the rectum around which it is prolonged to be fixed to the coccyx. Subjacent to this fascia and separated from it by a little cellular tissue, are several muscles. The bulbo-cavernosi lie in the middle and form a sort of platform to the bulb of the urethra; externally to these, lies on each side, upon the corresponding corpus cavernosum, the ischio-cavernosus: there is a slight longitudinal furrow between the ischio and bulbo-cavernosi muscles. From the centre of the posterior margin of the muscular floor formed by the bulbo-cavernosi, a strip of muscle is sent back to the anterior part of the sphincter ani with which its fibres are blended. The muscular layer of the perinæum is completed by the transversi perinæi which lie deeper, and are stretched from the rami of the ischia to the centre of the perinæum, where all these muscles meet to form, with some of the fibres of the levatores

ani, a strong, dense, muscular intersection.

When these muscles are removed, we come to the bulb of the urethra and the second layer of fascia, which is called the triangular ligament or septum perinæi. It is attached to the branches of the ossa pubis and of the ischia on each side: at these attachments it is disposed as a simple aponeurosis; but, anteriorly and posteriorly, its disposition is more intricate. In the latter direction, when opposite the back edge of the transversi perinæi muscles, it becomes blended with the superficial perinæal fascia on the one hand, and with a fascia-form layer lining the external surface of the levatores ani, on the other. By means of this last layer it may be said to be reflected up to the origin of the levatores ani, and by means of the first, it winds round the rectum to be attached to the neighbouring part of the margin of the pelvis, namely, the sciatic ligaments and coccyx. As the triangular ligament forms a complete sep-

tum, closing the whole pelvic outlet, it must necessarily open somewhere to let out the urethra to the corpora cavernosa, and to admit of the rectum passing to the skin. We have just stated that it winds round the rectum, or rather opens to let through this intestine; and, as all fasciæ are reflected, or send a prolongation upon parts passing through them, the layer upon the levator ani muscle should be considered as a reflection given off to the intestine as it traverses the triangular ligament. The same thing occurs anteriorly: at the distance of one inch and a quarter beneath the symphysis pubis, and half an inch below the edge of the pubic ligament, the triangular ligament opens to let through the urethra; and then, from the edge of the opening it sends a prolongation backwards, which strengthens and forms a kind of sheath to the membranous portion of the urethra, and so becomes continuous with that layer of the fascia of the pelvis constituting the capsule of the prostate.

This opening for the urethra has been

described as a regular foramen, but it is rather a loop than a round hole. Perhaps its form will be better understood if we say, that where the ligament meets the membranous portion of the urethra, it divides into a right and left cornu, which, as they proceed to be attached to the pubic arch, leave between them a circular margin for this part of the canal to lie upon. Opposite the inferior border of the pubic ligament, each cornu splits into two layers, one of which is fixed to the cutaneous, the other to the pelvic surface of the symphysis pubis, so that the pubic ligament is included between them. It may be easily understood, how, from the membranous portion of the urethra being so narrowly embraced by the triangular ligament, it is, in reality, a fixed part of the canal.

The pubic ligament is the chief structure between the lower part of the anterior wall of the bladder and the skin, above the urethra. It is very strong and firmly attached to the pubic arch; its diameter from before backwards is three quarters of an inch.

When the triangular ligament is removed, we come to the inferior surface of the prostate enclosed in its capsule, and joined by its anterior extremity to the membranous portion of the urethra; and, it is here that a correct notion may be obtained of the position of these parts, and a just estimate formed of what I have stated respecting it.

Stripping off the thin cellular layer reflected from the triangular ligament upon the levatores ani, we perceive these muscles proceeding to the rectum, prostate, and membranous portion of the urethra; they form the contractile saddle by which these parts are chiefly suspended and supported against the pressure produced by the contraction of the diaphragm.

As that portion of the wall of the pelvis, corresponding to nearly the whole extent of these muscles, is lined by the fascia binding down the obturator muscle, there is in this part of the perinæum, a sort of elon-

gated, aponeurotic cavity extending from the symphysis pubis to the sacro-sciatic ligament.

The external boundary of this space is constituted by the obturator fascia, its inferior wall by the pelvic surface of the triangular ligament, and its internal boundary by the layer reflected from this upon the levatores ani muscles.

Beyond these muscles we arrive at the fascia of the pelvis, or great aponeurotic partition separating the peritonæum from the perinæum or floor of the pelvis. It is seen passing down from the rim of the pelvis to which it is attached, to the bladder and rectum. At the symphysis it constitutes the anterior ligaments of the former; and laterally, when arrived at the sides of the prostate, it forms the capsule of this gland; at the same time it joins the cellular layer reflected upon the outer surface of the levatores ani muscles, and is, in addition, continuous with the cellular tissue placed be-

tween the serous and muscular coats of the bladder. It is thus, that from forming the capsule of the prostate, this fascia is continuous, by means of the sheath of the membranous portion of the urethra, with the triangular ligament; and that all these, to which, for facilitating description, distinct names have been given, might reasonably be spoken of as different parts of the same fascia.

It will naturally be difficult to conceive how the fascia of the pelvis can become the layer covering the inferior surface of the prostate, since the fibres of the levator ani muscles are placed between them. The fact is, these fibres are attached to the prostate by means of two layers of fascia, and are included between them just as the tensor vaginæ femoris muscle is placed between and attached by means of two layers of the fascia lata. Were we to describe the fascia lining the bottom of the prostate and forming the greater part of its capsule, as proceeding from the median

line laterally; we should say, that when it reaches the margin of the gland, it divides into three layers, two of which enclose, as in a sheath, the levator ani muscle, whilst the other is continued upon the bladder, under its peritonæal coat: of the two first layers, the inner one is the fascia of the pelvis and lines the inner surface of the levator ani, the other is the layer reflected on the outer surface of this muscle from the triangular ligament.

But the fascia of the pelvis or recto-vesical aponeurosis is generally described as proceeding downwards from its attachment to the rim of the pelvis. In this case, we must say, that it descends, lining the bones and obturator muscle, till it reaches the upper border of the levator ani, and that at this border it splits into three layers, an internal one which invests the internal surface of this muscle, forms the capsule of the prostate, and is reflected upon the bladder and rectum between their serous and muscular coats; a middle one which covers the ex-

ternal surface of the same muscle and is the reflected cellular layer of the triangular ligament; and an external one which continues to line the obturator muscle and is attached around the foramen thyroideum.

It is a question often raised and not without plausibility, whether the layers here described ought to be considered as real aponeuroses, or merely as layers of cellular tissue? To this it may be answered, that the muscles are separated by cellular tissue in this region as well as in every other part of the body, but that this tissue becomes condensed in certain points into an aponeurotic structure.

The fascia of the pyriformis, the obturator fascia, the inner layer of the fascia of the pelvis, the capsule of the prostate, the first portion of the triangular ligament, and the superficial perinæal fascia, near its attachment to the bones, are evidently aponeurotic; the other layers mentioned are only cellular tissue.

The arteries of importance lying in the perinæum are all branches of the internal pudic. This vessel, arising from the internal iliac, descends anteriorly to the sciatic plexus of nerves and pyriformis muscle, and emerges from the pelvis, or rather begins to coast the margin of its outlet, at the inferior part of the great sciatic noteh, between the last named muscle and the levator ani, lying on the outside of the spine of the ischium. It re-enters the pelvis at the lesser sciatic notch, inclining downwards and inwards to the tuber ischii, and passing between the two sacro-sciatic ligaments, to the anterior one of which it is united. The artery then proceeds forwards between the levator ani and obturator muscles, but close to, and in immediate contact with the latter and with the tuber ischii to which it is bound down by the obturator fascia. When it reaches the origin of the ischio-cavernosus muscle, it divides into two branches, or rather gives off inferiorly the branch called perineal,

or, the superficial artery of the perinæum. This is a very important artery; it does not always arise at the same point, but is always large at its origin. It runs obliquely forward towards the scrotum, diminishing rapidly in volume as branches emanate from it, in the depression between the ischio and bulbo-cavernosi muscles, covered by the superficial perinæal fascia towards the surface, and by the transversus perinæi muscle on its pelvic aspect.

The perinæal artery sends branches to all the surrounding parts: some, which go to the rectum, have been called hemorrhoidales inferiores; and one, running rather transversely, which is sometimes furnished by the trunk of the internal pudic, is termed the transversa perinæi superficialis. After furnishing this branch, the main trunk of the internal pudic artery continues its course under the obturator fascia, running on the pelvic surface of the transversus perinæi muscle and concealed by the ischio-ca-

vernosus and ramus of the os pubis, on which it lies till it arrives at the symphysis. About three quarters of an inch anteriorly to the origin of the perinæal artery, it furnishes the deep transversa perinæi or artery of the bulb. This branch runs across and a little forwards, in the substance of the triangular ligament, to the bulb of the urethra, to which it is entirely distributed; it is not quite so large as the perinæal artery and lies, we repeat, deeper, or on the pelvic aspect of the transversus muscle. The trunk of the internal pudic is ultimately distributed to the penis.

The arteries we have described have corresponding veins, which are generally larger or more numerous than they.

The internal pudic nerve supplies the perinæum with branches. Formed by the third, fourth, and sometimes fifth sacral nerves, it accompanies the artery and divides into a superficial branch distributed with the perinæal artery, and a deep branch

which runs with the main arterial trunk, along the ramus of the ischium and os pubis to the dorsum of the penis. They both supply the surrounding parts with filaments.

The anatomy of the region of the anus is much more simple than that of the perinæum. It is bounded anteriorly by the line passing from one tuber ischii to the other, immediately in front of the anus; posteriorly, by the coccyx and what are called the coccygei muscles, and laterally by a part of the tuberosities and the sacro-sciatic ligaments. The transverse diameter of this region taken at the back-part of the tuberosities, (that is, at the widest part of the pelvic outlet) is, as we have stated, three inches; taken elsewhere it is rather less. The anterior and central part of this region is occupied by the curvature and termination of the rectum.

Almost immediately under the skin, we find the sphincter ani muscle, surrounded

by a great deal of fat cellular tissue; under this is the superficial perinæal fascia united to the posterior cornua of the triangular ligament and proceeding with them to be attached to the margin of the outlet; then we arrive at the levatores ani muscles, of which the posterior fibres form those termed the coccygei, all covered by the cellular layer reflected from the triangular ligament; and, finally, when these are removed, we come to the fascia of the pelvis, which is seen here reflecting itself from the walls of the cavity upon the rectum, as it is reflectd anteriorly upon the bladder.

The vessels and nerves found in this region in addition to those already described are the hemorrhoidales furnished by the internal pudic, and those which creep upon the intestine; they are of no importance in reference to the subject of this work.

As the curvature of the rectum may be fairly said to occupy the whole central part of this region, there is no room to at-

tack the bladder through it on the median line, without cutting through the anterior part of the rectum, an operation we shall have occasion to notice, and in regard to which, as well as in many other respects, the anatomy of this portion of the pelvic outlet is important.

LITHOTOMY BY THE PERINÆUM.

Lateral Operation.

It is now time to examine the different mechanical means of treating stone in the bladder, and to see how far they tally with the anatomy and functions of the parts we have described and with the nature of the disease in its different stages and varieties, in order that we may, if possible, methodize and improve them.

For this purpose, it will not be necessary to include in our survey plans that are obsolete, such as the operation of Celsus and that by the *grand appareil;* we shall confine ourselves

to the consideration of the most approved and most extensively adopted methods of operating. These are the lateral, or rather lateralized operation, (*operation lateralisée*) in the perinæum, as performed by Frere Cosme, Cheselden, and with slight modifications, by practitioners of the present day; the operation by the rectum revived by Samson and practised by him, Vacca and others; the high operation or cutting above the pubes; and lithotrity. It is not our intention to give a full and complete description of the above modes of operating; our object being only to enter into such details as will enable us to point out the objections to which they are liable, the improvements of which they are susceptible, and the cases to which they are adapted.

Of the different plans of performing lithotomy, the lateralized operation is by far the best in the great majority of cases. The best mode of performing it is that which is most simple: to be simple there must be but few instruments used, and they

should be such as the operator can completely guide and manage; the cutting ones must be so constructed that he can exactly appreciate, limit, or extend, the incisions they make. A straight, strong, pointed bistouri, three inches and a half long in the blade, and four in the handle; Frere Cosme's sheathed knife (*Lithotome caché*) as I have modified it; a straight, narrow, probe-pointed knife three inches long in the blade and six in the handle; a staff, syringe and blunt conductor, and divers forceps are the essential instruments; those incidentally necessary, such as needles, a tenaculum, a common dissecting forceps, canulæ for plugging, and the actual cautery should be in readiness.

I shall first explain what alterations I have made in the *lithotome caché*, and then briefly describe the operation as I prefer performing it. The original instrument consists of a sheathed knife four inches long, curved so as to be convex on its cutting edge; and of a handle with a spring

for unsheathing and sheathing the knife, which passes from and into the sheath edgewise. The sheathed knife which I use, opens in like manner; but it is straight, wider than the original one, cutting in its whole extent, and only two inches long in the blade. Where the blade joins the handle, there is a sort of stop or hilt to prevent this part of the instrument going beyond the prostate; the handle is thin and six inches in length.

After the preliminaries of shaving the skin, sounding and fixing the patient, the first thing to be done by the operator is to measure anew the perinæum; I say anew, because it is the duty of the surgeon to examine the pelvic outlet carefully, before he even attempts to decide upon operating: he should feel with his finger the margin of the inferior aperture of the pelvis and observe well the position of the rectum. In the next place, let him mark with the left index finger the point on the median line, one inch and a half below the symphysis

pubis, and again feel the tuber ischii with his right, always keeping an eye to the situation of the rectum. The assistant should now put the bistouri into the right hand of the operator, who is to make his first incision from one of these points to the other, through the skin, cellular tissue and superficial fascia: it is generally made straight, but I like to curve a little round the rectum; it should diminish in depth from the upper to the lower angle.

The next step is to dissect by two or three cuts, at the upper angle of the incision, up to that part of the staff corresponding to the membranous portion of the urethra, and thus to divide, in the furrow between the bulbo and ischii-cavernosus muscles, the transversus perinæi and triangular ligament; the left index finger always protecting the rectum and serving to guide the knife. When the way is quite clear and any large artery secured that may happen to have been wounded, the membranous portion of the urethra, to which the nail of

the left index is the natural director, is to be opened from the bulb to the prostate. The operator keeps his nail in the groove of the staff, which must now be held quite still, and passes the end of the sheathed knife thereinto; then, laying hold of the staff with his left hand, the sheathed knife being held in his right, he gently passes both together into the bladder: the former was there, and therefore only passes farther in; the latter goes in up to the hilt.

The staff being withdrawn, the left index is again passed into the wound to protect the rectum; with the right hand, the operator, after giving the sheathed knife the obliquity he wishes, opens it, and by steadily withdrawing it, divides the prostate to the extent previously fixed upon. The obliquity should be just sufficient to preserve the rectum.

This may be termed the first stage of the operation. The operator now passes his left index into the wound in the prostate

and appreciates its extent; if it should be too limited, let him keep the finger there as a guide, and enlarge it with the long-handled, blunt pointed knife, carefully protecting the rectum. In those rare cases where the finger cannot fairly reach the wound, the extent of the latter may be measured by two straight sounds a foot in length. When the perinæum is shallow, the stone may often be felt, and if small, scooped out with the finger, or if large removed by a forceps passed in upon it; but when the perinæum is deep, a blunt conductor must be passed into the bladder, either on the finger or upon a straight sound, in order that the forceps may have a safe and easy passage. When the stone is seized; it should, if not spherical, be extracted endwise, so that one edge be turned forwards and the other backwards. The operator should take time to dilate (if dilate he can) the opening, by gentle pressure, and not risk tearing the bladder, in removing the extraneous body; which should be drawn round the posterior boun-

dary of the incision in the prostate, in the direction of a line running from this gland towards the ischiatic tuberosities. The bladder is afterwards to be cleared of all fragments, and injected with warm water narcotized with a few drops of Batley's laudanum. If any artery bleed profusely let it be tied, if possible; but, should the attempt to secure it be unsuccessful, the patient must be put to bed and left to bleed to the extent his situation may require, or even a little more. It is to be hoped the hemorrhage will then stop of itself; but should it continue, the surgeon must put his finger on the spot whence the blood issues, set himself down by the bed-side and exercise pressure; when one finger is tired, he can substitute another by passing them close together.

An irksome job this, (I can say from experience;) but it is, perhaps, the only safe means of arresting the hemorrhage. In some cases, the actual cautery directed through a canula to the bleeding vessel,

must be had recourse to. Plugging round a canula passed into the bladder is scarcely less dangerous than cauterising, and not half so sure. Other means recommended to stop the hemorrhage are not worth a straw.

As to the preference deserved by any particular modification of the process to be followed in the lateral operation, it surely ought to be given to that, by which the Surgeon can measure and direct his incision through the prostate.

Gorgets are bad, and all instruments are bad, which are thrust through the prostate from the urethra; for this simple reason, that it is impossible to measure precisely the extent of the incisions they make. It is stabbing in the dark. The position of the end of the staff cannot be always appreciated with certainty, and however successful some operators may have been, who use the gorget, nothing but great good luck can preserve them from dangerous accidents.

Of the patients who submit to the lateral operation, one in seven or eight dies; and, in almost all those cases which have a fatal issue, death is produced either by the force used to extract the calculus or by too extensive an incision in the prostate. If the incision is small in comparison with the stone, death will follow from the violence done to the bladder and surrounding parts, in the extraction; and if the incision is made sufficiently extensive to admit of the fair extraction of a stone one inch and a half in each of its two lesser diameters, death will follow from infiltration of urine.

In criticising the lateral operation, the first thing to be attended to is, then, the volume of the stone; success or failure depends upon it. If the foreign body never exceeded three inches in its lesser circumference, so that the incision in the prostate might be limited to three quarters of an inch or a few lines more, the operation when well performed, would seldom or never be followed by fatal consequences. When it

measures four inches and a half in its lesser circumference, or that the sum of its two lesser diameters amounts to three inches, the patient may recover, but the chances are very much against him; and when it exceeds this volume, death is almost sure to be the result of the operation.

The Surgeon is in this dilemma,—he must either use force, or make a long incision; the former lacerates the prostate and cellular tissue, bruizes the bladder and stretches its membranes, and shocks the nervous system; the latter prepares the way for infiltration of urine: both are fatal nearly to the same degree.

Let us proceed to the proof of what has been advanced. We have seen that the largest transverse diameter of the pelvic outlet, taken from the bare bones, is only three inches, and that opposite the prostate it is only one inch and three quarters; it should be recollected too, that as the incision is made only on one side, the whole of this

space is far from being available. When the stone is drawn, as it should be, round the back part of the incision, and then, in a direction nearly parallel to the superior aperture of the pelvis towards the rectum, the parts pressed between it and the inferior margin of this cavity will certainly yield considerably; but more than an inch and a half will seldom be obtained by moderate pressure.

But, the great obstacle to the extraction of a stone measuring an inch and a half in its lesser diameters is the situation of the prostate. The calculus must pass between the inner surface of the rami of the ossa pubis, and the posterior boundary of the incision in this gland; and, as the distance between these, when the incision in the prostate is not dangerously extensive, is only an inch and a quarter, it necessarily presses the anterior wall of the bladder against the bones, on the one hand, and tends to tear the back part of the prostate, on the other. As the prostate is firmly

fixed, it cannot be drawn backwards, or pushed farther from the bones towards the cavity of the pelvis, without the ligaments yield or break; yield they may, perhaps, a quarter of an inch without laceration, and then a stone of the above size may be extracted, possibly without mortal injury.

But when the foreign body is larger, something must give way: the bones cannot yield, and if the calculus be not crushed, the prostate and bladder must be torn; and the effects of this laceration is almost certain death.

If we have described the parts correctly, the inference that laceration must occur either in the prostate and bladder, or in the tissues by which they are fixed, cannot be disputed.

The next question will be, ought not this to be prevented by an extensive incision? But, before entering upon it, we have

to prove the truth of the last conclusion, —that the effect of laceration is death.

The experienced surgeon will admit, that in one half the number of cases which terminate fatally, death is the result of force used to extract the stone; and whoever peruses attentively the history of such cases detailed with the post mortem examinations, will come to the same conclusion. But, setting aside, for the present, the positive evidence afforded by these cases with which the records of surgery teem, and which are familiar to the memory of almost every practitioner, let us look at the natural effect of those injuries, which are inseparable from the employment of force in the extraction of calculi.

In the first place, when the prostate and bladder are torn or much contused, death will often result from the immediate shock of the injury. Secondly.—If the fascia forming the capsule of the prostate, or that constituting the ligaments of the blad-

der, or even the neighbouring cellular tissue be torn or severely bruised, death will ensue from suppuration and sloughing occurring either in the cellular tissue of the pelvis, or in some tissue or organ more or less distant from it. Thirdly.—The same result will follow from the infiltration of urine, which is so frequently produced by the above injuries.

It is universally admitted that the contusion of any internal organ is almost necessarily mortal. A patient rarely survives contusion of the brain, lungs, heart, liver, spleen, kidneys, stomach or intestinal canal; if the arachnoid membrane, the pleura, pericardium or peritonæum be stretched or torn to any extent, death will soon follow; indeed, if the injury be only very slight, it will be almost always succeeded by inflammation of a kind which rarely admits of recovery. How then can it be supposed that similar injuries of the bladder,— the bladder composed of peritonæum, mucous and muscular membrane,

the bladder with its abundant nerves and vessels, and its venous plexus; the bladder containing urine, and surrounded on all sides by aponeurotic structures; the bladder so intimately connected with the genital organs,—are exempt from a similar result?

If it go hard with life when a large joint is violently distended, a muscle torn, or a nerve lacerated, what are we to apprehend when such injuries are inflicted upon the urinary reservoir?

The use of force to extract a stone is so surely followed by death, that I shudder to think how often Surgeons have recourse to it. It has so generally occurred to me, to foretell the issue of a case simply by the degree of force employed, that, if I witness it now, I do not hesitate in indicating to those near me when the operator has arrived at the point beyond which recovery is impossible. I shall shew presently, that a large opening in the prostate,

made scientifically with the knife, is too dangerous a lesion to be allowed much longer to belong to surgery; but dangerous as it is, one would almost call it a safe and simple wound, when compared to the injury inflicted by a surgeon, who, placing his foot against the table, employs all the strength he possesses, to stretch and tear the bladder, lacerate its connecting tissues, bruise the surrounding parts, and shake, mortally shake, the whole nervous system! This anti-physiological process, this absurd and horrid practice, is so cruel, so fatal and yet so common, that there is nothing in which, as a surgeon, a man might more justly pride himself, than having contributed to abolish it. But let us pursue the investigation.

When the bladder is full, a violent contusion on the hypogastric region, such as we sometimes see from the kick of a horse, is frequently followed by suppuration of the cellular tissue in the vicinity of the organ, and in this event, always by death.

In extracting a stone with force through an opening in the perinæal portion of the bladder, we produce the same kind of injury; there is, however, this great difference, that the parts interested are much more vascular, nervous and delicate in the latter than in the former case.

I could refer to individual operations of lithotomy, where patients have expired on the table or a few hours afterwards, from the shock communicated to the nervous system by the forcible extraction of the stone, or to those less immediately but as certainly fatal, where the patient has lived weeks without ever being able to rally; but they are too notorious, too much every-day occurrences to require detailing in this place. If it ever occurred to the operator, during the athletic efforts made to extract the calculus, to ask himself what he was pulling at, would not the answer which anatomy suggests compel him to desist? he is not merely dragging out a stone, and pulling at the bladder,—its delicate and

tender membranes—its vessels and important connexions;—but, at its nerves, and by means of these,—at the hypogastric plexus—the great sympathetic—and spinal marrow! This is the simple physiological explanation of what follows the operation, or the plain analysis of what is called the shock communicated to the nervous system by wrenching a stone with force from the bladder.

When this mode of proceeding is not so immediately disastrous, and even when the patient escapes suppuration in the sub-peritonæal tissue of the pelvis, he is often exposed to suppuration of the cellular tissue in some part or other. I have seen more than once the sub-cutaneous cellular tissue of the back, loins and gluteal regions slough so extensively, in so peculiar a manner, and with such dreadful constitutional effects as to defy all curative means.

Internal inflammations which so often carry away the patient, result from the same

cause. They always present the same peculiar character—running quickly into suppuration, in spite of every means that can be devised to prevent it. In one case I found several of the large joints filled with pus. Indeed, whether this distant inflammatory, or rather pus-making, process (for some such term might be used to characterize it) attacks synovial membrane in the limbs, or serous membrane in the head, chest or abdomen; or whether it be directed against a parenchymatous organ, nothing will check it; the result is almost always the same.

Among those who are accustomed to apply force in this operation, I have never met with one, who was prepared to deny that these effects frequently ensue from it; but, they adopt it from the dread of enlarging the incision, and from entertaining a blind hope in the possibility of dilating the wound. Let them, however, refer to their anatomical knowledge, and then say candidly whether they ought to rely upon such a chance; whether, in fact, the

anterior ligaments of the bladder, the prostate and its capsule are of a dilatable nature, or likely to yield without serious injury. My experience obliges me to assert, that generally, when they give way to force, their substance is irreparably injured.

Laceration of the prostate and adjacent tissues prepares the way for infiltration of urine nearly in the same manner as a long incision, the effects of which we have now to consider. To extract a stone measuring an inch and a half in its two lesser diameters, requires an incision in the prostate at least an inch long. When the incision is carried to this extent from before backwards, the urine, as it escapes from the wound after the operation, comes in contact with so much of the fascia, and approaches so near to the sub-peritonæal cellular tissue, that the patient is necessarily exposed to their sloughing, and consequently to destruction.

Wherever the urine lodges, it produces

sloughing, and if any insinuate itself beyond the prostate, the mortification will gradually spread backwards, till, at last, it destroys the patient.

Many of the dissections I have made shew this to be the fact. But, it may be necessary to make the incision still longer; and if so, some of the fibres of the levator ani, which descend more and more from before backwards, will be divided, and with them, of course, the reflected layer of the triangular ligament covering their external surface; and what follows? Why, when these are divided, the urine passes with the greatest facility, back along this muscle, in immediate contact with the external surface of the fascia of the pelvis, which posteriorly, near the rectum, forms a very inefficient barrier to its ravages. This fascia, when soaked with urine, sloughs; the neighbouring tissue suppurates, and the whole subperitonæal tissue soon becomes implicated.

When much urine is suddenly infiltrated

as it often happens after a long incision or laceration of the prostate, death will occur in a very short time, as the natural effect of the contact of this fluid with a large extent of living tissue; and even when it is not effused in sufficient quantity to act as an immediate poison, it often produces sympathetically that peculiar kind of peritonitis which carries off the patient almost as speedily. If there be but little urine infiltrated, the patient may appear to be going on well for weeks; but, he is not the safer on that account; the wound will not heal, and although suppuration advances by slow and imperceptible degrees, the patient cannot recover. This I have witnessed often and often. I recollect well a case in private practice that occurred to a friend of mine, in which every thing promised success till about six weeks after the operation; when it became evident that suppuration was going on somewhere: the patient died; and we found a small track of pus extending from the back of the wound into the pelvis, whilst the whole pe-

ritonæum was in a state of suppuration. When urine is infiltrated, however small the quantity, nature has to struggle with a deadly enemy, whose insidious character does not at all lessen the fearful odds against her.

Some are of opinion that infiltration of urine is not much to be feared, unless the fascia of the pelvis be divided beyond the prostate; when, they admit, it is almost certain to occur; but, be it recollected that the capsule of the prostate is a part of the fascia of the pelvis, and that the suppurative inflammation we speak of, has to spread only a few lines by direct continuity to affect the sub-peritonæal tissue. If the incision in the prostate be made too horizontally and extend to its margin, (where the capsule may be said to split into layers, two of which enclose the fibres of the levator ani,) the urine will be sure to sojourn among these fibres and work its way towards the pelvis; and nine times out of ten the case will end fatally.

It would be difficult to say geometrically how long the incision may be made without danger; and, I certainly have not the presumption to draw precisely the line, on one side of which is safety, and on the other death; but, I am convinced from meditation on the anatomical facts connected with this subject, and from the painful experience of seeing many die, that the danger of a wound in the prostate is in the direct ratio of its extent, and that an incision necessary for the extraction of a stone measuring an inch and a half in its two lesser diameters, puts life in imminent peril.

Of the two evils—the use of force, or a long incision—there can be no doubt which is the minor; since the latter subjects the patient to only one serious danger, whilst by the former he is exposed to many fatal consequences.

My opinion is, that Surgery should claim as an axiom—that a large incision is al-

ways preferable to force sufficient to contuse and lacerate the prostatic, or any other part of the bladder, or the fibrous tissues surrounding it;—but, surely, the lesser evil will be considered too serious to be tolerated, when it is recollected that nearly half the patients who die, succumb to the infiltration of urine it occasions.

Nothing can exceed the dread which lithotomists have of a large incision: their instruments are almost invariably constructed so as to prevent it. Yet, what can be done? This is the question always put to himself by a good operator upon discovering that he has to deal with a large stone; a question we hope to be able, as it is a part of the design of this work, to answer. I have frequently been a witness, and I may say a sympathizing witness of the terror and extreme embarrassment felt by the surgeon at the moment of this discovery: if he thought of enlarging the wound, the certainty of exposing his patient to infiltration of urine would flash

across his mind; and, on the other hand, his knowledge of the inevitable consequences of lacerating and bruizing the parts, would incapacitate him for having recourse to force. Many, I admit, do use force in the hope of dilating the wound, as I have already observed; but this is not possible to any extent.

By these facts we may judge, then, how reluctantly operators adopt a long incision. And if laceration of one of the most delicate, most sensible, and most important of the internal organs be preferred by some operators to a large opening made with the knife, and that both means are had recourse to only as their desperate *pis aller*, surely it is high time to think of treating stone in the bladder, by some more rational process than lithotomy as it now stands.

Cases where the patient has expired, from a few minutes to sixty or seventy hours after the operation, in consequence of the shock communicated to the nervous

system by the use of force in the extraction of the calculus, are so frequent that I cannot believe it necessary to narrate them; besides, there is something so dreadful on the face of them, that it would be an invidious task to select and point to any particular instances of this kind, unless occurring in one's own practice; and even then, it would require a great effort to muster sufficient courage to put them in print. As it is, however, I have not yet had the misfortune to perform lithotomy where the stone was large, and therefore have escaped the necessity of causing those fatal results, which otherwise, I confess, it might have been my painful duty to record.

To justify the conclusions we have come to, as to the merits of the lateral (which is certainly the best) method of performing lithotomy, I shall therefore insert in detail, a few fatal cases of that kind only where death has been less immediately the consequence of the operation, and spare the reader the perusal of those which it is as

difficult to describe, as to witness with temperate feelings.

In 1829, I was present at two operations of Lithotomy so perfectly similar in every respect as not to require a separate description.

CASES, 1 and 2.

In each case, the stone measured nearly an inch and a half in its two lesser diameters. The cutting part of the process was performed with the greatest dexterity, and every thing was done scientifically till it became necessary to extract the foreign body, which the wide separation of the branches of the forceps indicated to be frightfully voluminous. I shall never forget what occurred then: the operator placed his left foot against the table, swung the whole weight of his body upon the forceps, and after several minutes forcible traction exercised amidst the ominous groans of the patient, succeeded in

wrenching away the calculus. The patients were removed to bed in that state of moral and physical depression, which, to the operator himself left no hope of recovery. One lingered till the fourth day; the other, not quite so long: in neither was there any reaction; and as, at the post mortem examination, nothing morbid was visible, the conclusion come to, was, that death had resulted from the shock of the operation.

Case, 3.

Protot François, aged 22 years, of a good constitution and sanguiferous temperament, had been subject to derangement in the urinary apparatus for fifteen years, and had frequently passed small calculi by the urethra. On the 15th of April, 1822, he entered the Hotel-Dieu, complaining of the usual symptoms of stone in the bladder; he suffered intensely in voiding his urine, which contained no blood, but a great deal of mucus. A spare diet and baths were ordered. On the 12th the patient

was sounded and the stone recognised. On the 15th, the operation was performed according to the plan of Frére Cosme, or (*méthode lateralisée.*) Incisions were first made through the soft parts of the perinæum up to the membranous portion of the urethra; this canal was then opened to admit the sheathed knife, which was passed into the bladder, opened,and then withdrawn unsheathed, so as to divide the prostate to the extent of a little more than an inch. The stone, which appeared to be very large, was extracted with great difficulty; after several attempts to remove it, which lasted eight or ten minutes, its external layers at length gave way and were crushed; it was then wthdrawn without further violence. As several of the fragments escaped from the forceps, a few minutes were occupied in clearing and washing out the bladder.

The patient was carefully put to bed, and an antispasmodic *tisane* was ordered. He passed the day tolerably well, although he seemed much depressed; towards evening

some uneasiness was felt at the lower part of the abdomen; it seemed however, to be occasioned by the passage of gaz in the intestines. On the 17th, there came on vomiting with increasing uneasiness in the abdomen. Forty leeches were applied to the abdomen, and diluent drinks given plentifully.

There was some abatement in the symptoms in the night, but no distinct remission. On the 18th, twenty more leeches were applied to the abdomen, and twenty to the perinæum. The patient was also placed in a bath. On the 19th, the vomiting had disappeared, but the features were much changed; the pulse was wiry, the skin hot and dry, the tongue somewhat parched. More leeches, purgatives, baths and fomentations were had recourse to, but without effect: the patient died on the 21st.

Necropsy.

The parts in the vicinity of the wound,

were macerated in a brown, purulent fluid. The whole of the cellular tissue of the pelvis was infiltrated with thick pus; this infiltration extended into the lumbar regions and filled the iliac fossæ.

The peritonæum presented, to the extent corresponding to the suppuration beneath it, abundant pseudo-membranous productions uniting the small intestines to one another and to the bladder. The other parts of the body were healthy; the tissue of the kidneys seemed, however, to contain a little more black blood than usual.

In this case, we find a powerful effort was made to extract the stone, which at length yielded to the pressure of the forceps; but considerable injury had been done in the attempt to get it through the opening; much more, I conceive, than in the reiterated introduction of the instrument afterwards for the purpose of bringing away the fragments. The natural consequence followed. The fascia and tissues

in the neighbourhood of the bladder, loosened and bruised by the forcible traction made on the stone; immediately sloughed or entered into a sloughing suppuration,—a state which the contact of the urine in the immediate seat of the wound evidently favoured. Bleeding had not the slightest effect in preventing or diminishing the disorder; the physical injury done in the operation being quite beyond the reach of antiphlogistic or any other means.

Some time ago, Baron Dupuytren, deeply impressed with the difficulty and danger of extracting a large stone, and imagining that they might be partially obviated by an incision occupying the whole breadth of the perinæum, revived and improved the operation of Celsus. In this method the prostate is divided by a semilunar incision, or almost horizontally, on a level with its junction with the urethra; therefore, the inision extends very near, if it does not interest the margin of the gland, where its capsule splits and becomes continuous with

the different layers of the fascia of the pelvis. One of the evils belonging to this plan is, of course, the facility with which the urine makes its way between these layers; and as the consequences are precisely those which are observed when, in the lateral operation, the incision is made too horizontally, I shall insert one or two cases to illustrate this point, and farther to exemplify what has been stated generally respecting the effects of lithotomy when the stone is large. First, however, it may be right to remark here, that a still greater objection to the horizontal method is the impossibility of withdrawing the stone in the direction we have so much insisted upon, as the only one offering any chance of safety.

Case, 4.

Chenaud. Jean Charles Pierre, a Baker, 63 years of age, rather robust, of a good constitution, was admitted at the Hotel-Dieu, Feb. 8th, 1825.

He complained of shooting at the end of the penis, and severe pain in making water, accompanied by tenesmus and unavoidable excretion of the fæces; the efforts to empty the bladder were almost incessant, so that he might be said to labour under the most distressing incontinence of urine. These symptoms had existed for six years; but, within the last fifteen months, they had become so violent as to oblige the patient to relinquish his occupations.

Three weeks prior to his admission at the hospital, he applied, for the first time, to a Surgeon, who sounded him and discovered a stone in his bladder.

The 8th, Feb. he had a warm bath, and was put upon spare diet. On the 9th, Baron Dupuytren sounded him and declared he had a large stone in the bladder. On the 14th, all being well, the operation of lithotomy was performed by the bi-lateral plan; that is, by a horizontal but rather curved division of the prostate, nearly resembling that made in Celsus' method of cutting.

The man, whose large intestines had been emptied by an enema, was placed in the customary position, and the stone recognised by a staff left afterwards to the care of an assistant. The operator first made an incision through the skin and superficial fascia, half an inch anteriorly to the fore part of the anus, curving round the gut, so that its convexity was towards the scrotum and its extremities corresponded to the ischiatic tuberosities; one or two others of the same form, carried very obliquely upwards, served to divide the bulbo-cavernosi muscles and other soft parts, till the membranous portion of the urethra was laid bare. This portion of the urinary canal, was now opened longitudinally, so as to admit of the introduction of the double *lithotome caché*, which was easily passed into the bladder.

The division of the prostate was now effected with this instrument, opened to an inch and a quarter, and drawn through the gland, from behind forwards. The stone

could not be extracted without great force and the most excruciating pain, although, as it appeared afterwards, it was seized most favorably. It was three inches long, nearly one inch thick, two inches broad at one end and one inch and a quarter at the other.

The patient who had lost ten ounces of blood during the operation, which lasted fifteen minutes, was conveyed to his bed in a state of extreme depression. Anti-spasmodics were administered, and during the day, a small quantity of blood issued from the wound with the urine. In the night he had a little sleep.

On the 15th. The man's countenance seemed to me to be deeply altered; the pulse was frequent and small, the tongue white, and rather dry: when questioned and roused, he complained vaguely of aching and weight in the hypogastrium. Fifty leeches and large hot poultices were applied to the abdomen. On the 16th, the patient was evidently sinking; his constitution

seemed broken by the shock it had received, and at intervals he had hiccup and regurgitation. The urine appeared to flow out properly from the wound. The antispasmodic drinks were continued and a little broth was administered. During the night the abdomen enlarged; yet the patient seemed drowsy.

On the morning of the 17th, the patient said he had slept, and was quite unconscious of his danger; but his face was that of a dying man; the pulse was feeble and wiry, the skin clammy, respiration difficult, the abdomen swollen and tense, and the tongue dry. (Hot lemonade; leeches to the perinæum and groins.) From this time he gradually sunk, and expired at two o'clock.

Post-mortem Examination.

The abdomen was distended principally by gas contained in the intestines. There was altogether about half a pint of fluid in

the cavity of the peritonæum; it was sanguineous in some places, in others puriform. The bladder was ample; on being opened at its upper and back part, so that its neck could be well seen, the prostate presented a horizontal opening dividing it into a superior lip, formed partly by the gland, but chiefly by the anterior wall of the bladder, and continuous anteriorly with the urethra; and an inferior or posterior lip constituted by almost all the thickness of the prostate united anteriorly to a small triangular flap of the urethra. The whole breadth of the prostate was interested and the opening had been partially made by laceration.

The perinæum, dissected from the skin towards the bladder, presented the external opening immediately before the lower part of the anterior wall of the rectum; it contained a dark-coloured sanies. Under the superficial fascia, the muscles were completely dissolved in this matter. From this place the disorder was traced under the sides of the bladder all round the pel-

vis, the cellular tissue and fascia of which were infiltrated with it, as far as the right iliac region, where the iliac muscle was soaked in it, and even along the ureters. There was some pus of a better kind in the vicinity of the left kidney.

The ureters were dilated to a caliber one third greater than usual. Their mucous membrane was greyish. That of the bladder offered inferiorly two deep-red patches somewhat like slight ulcerations, where it seemed to have been injured.

The patient had an irreducible inguinal hernia formed by omentum and a large portion of the great arch of the colon, which descended before the small intestines into the sac, circumscribing a sort of triangular area in the abdomen. The omentum was placed in the sac before the gut. Something like an old cicatrix existed at the inferior surface of the right lobe of the liver. The other organs presented the state usually observed in similar cases; they were not visibly diseased.

Here we have a fair specimen of immediate and extensive infiltration of urine in the pelvis and along the ureters, resulting from a large horizontal incision and a little laceration; one of those cases, too, where the patient's life may be said to have been extinguished on the table, by the force required to get away the stone. Either of these causes, alone, must have produced death, although the former in all probability would have been less rapidly followed by such an issue, supposing an incision could have been made large enough to admit of the removal of the foreign body without violence.

After such a shock, the heart continues to beat, the lungs to do their office; but, the organs that supply the more essential part of being—those of the nervous system—are utterly disabled as in concussion of the brain.

Case, 5.

Ternisien Victor, aged 22 years, was ad-

mitted at the Hotel-Dieu, March 12th, 1825.

He declared, that from his infancy he had experienced pain and difficulty in voiding his urine, although, during certain intervals, the symptoms had been intermittent. He had been sounded in 1815, when a stone was recognised in the bladder; but as the symptoms were not very urgent, no curative means were then employed.

On the 12th of March, the patient's sufferings were truly distressing; the most acute pains returned at very short intervals; the fæces were involuntarily excreted by the violent contraction of the abdominal and perinæal muscles, which took place to expel the urine whenever the fluid was accumulated in the quantity of two or three ounces; and all the usual symptoms of stone existed, to an intense degree. Being of rather a plethoric habit, he was prepared by purgatives and a spare and regular diet, till the 29th, when the operation was performed by the horizontal method.

The stone which, as was afterwards seen, was equal in size to a large walnut and of a globular form, could not be extracted without considerable force exercised amidst the patient's shrieks, and the violent convulsive contraction of his abdominal muscles.

As little blood had been lost during the operation, the patient was bled shortly after it: a large, soft, hot poultice was applied to the abdomen and an antispasmodic mixture administered. Notwithstanding these means, he passed a restless night, and in the morning of the 30th another bleeding was performed. After this he seemed better, but on the 2nd of April, he complained of uneasiness in the gluteal region; his pulse was frequent, the skin hot. April 3rd, fifteen leeches were applied to the painful part. April 5th. Shivering and increase of fever, with great restlesness. (Seven leeches; Mixture containing an ounce of the *Syrup. Papaver.*)

The following days, the same symptoms

prevailed, although the urine flowed freely from the wound and leeches were applied in abundance.

The 10th instant. It was ascertained that pus had formed in the cellular tissue of the left gluteal region; and a large opening was made which gave issue to a great quantity of it, of a fetid nature, and mixed with gas. The countenance was anxious and dejected, the pulse soft but rapid, the tongue white, the skin covered with copious perspiration. A little soup was now allowed. The 11th and 12th instant. The symptoms became alarming; the small pulse, dry tongue and general depression indicated a fatal issue. A little claret was administered, but on the 13th the patient expired.

Post-mortem Examination, Thirty-six hours after Death.

The skin of the whole of the posterior region of the trunk had a livid aspect, and under it, communicating with an opening in the left gluteal region, the cellular tis-

sue was every where infiltrated by a layer of thick, concrete, yellowish pus. The latissimus dorsi and glutæus maximus of the left side were equally drenched in pus, which extended under them as far as the pyriformis, but no farther. The kidneys were rather pale, but healthy; the right and its ureter were a little larger than those of the left side.

The bladder was contracted and empty; its mucous membrane had rather a brown aspect, and appeared somewhat thickened. Its prostatic portion presented a horizontal opening the lips of which appeared evidently contused. The soft parts of the perinæum were divided by a semilunar incision half an inch before the anterior wall of the rectum. Some of the lymphatic glands in the pelvis were in a state of suppuration; there was also some pus in the cellular tissue between the muscles of the upper part of the right thigh.

The brain and its membranes were in the state usually observed after death by

similar causes; there was a good deal of serum, infiltrated as it were, in the substance of the pia mater. The organs of circulation and digestion were healthy. The anterior border of the right lung presented a circumscribed abscess one inch in diameter; this appeared to me to be a true vomica. In no part of the body could a tubercle be found.

The striking feature of this case is the extensive sympathetic suppuration occurring after the use of force, in the extraction of the stone. I use the word sympathetic, because there was no immediate connection between the seat of the operation and that of the accident which followed it: a circumstance strikingly corroborative of the fact, that local violence in this operation is felt by the whole body: the shock in this case evidently vibrated through the whole frame, and so injured the constitution, that suppuration could not be arrested by the most active and speedy depletion. Pus was secreted even among the muscles

of the thigh and at the edge of the right lung, although the parts in the immediate vicinity of the wound were in a comparatively healthy state; so that, if the contused parts miraculously escape, the deposit of matter takes place elsewhere, by some such law as that, in virtue of which, abscesses form in the liver after a blow on the head: the cases are certainly analogous.

We have dwelt only upon the main objections to Lithotomy by the perinæum; but, there is one accident of so much weight and of such frequent occurrence that it ought to be taken into the scale also; I mean hemorrhage. The artery of the bulb, and the perinæal artery even at its origin are subject to be wounded by dexterous operators, and when they are opened, it is no easy matter to tie them. By small external incisions they may perhaps be avoided always; but, there are sometimes irregular branches which no dexterity can protect from the knife, because their situation cannot be foreseen.

I am inclined to believe, too, as far as my own observation goes, that in certain individuals, profuse and dangerous hemorrhage may sometimes take place from small, deep seated vessels about the neck of the bladder, which are totally beyond the command of a ligature. It is not only from hemorrhage itself, but frequently from the means necessary to arrest it, that serious and even fatal consequences are to be apprehended. The following case, which is interesting in many respects, may probably throw some light on this subject. I should premise, however, that it is not given as a specimen of what should be done to stop the blood in similar circumstances. I have already pointed out that the finger of an assistant is the best plug; it may be said to be a discerning tourniquet; and that is not its only advantage: the patient is always more confident and his mind is more at ease, when he has some one near him, on whom he can rely; and however tedious and toilsome the duty, I trust no Surgeon will shrink from performing it, when he con-

siders that it is to secure nothing less than the life of a fellow creature.

At the Hotel-Dieu, plugging to arrest hemorrhage after perinæal lithotomy, is performed thus:—a kind of linen purse, five or six inches in length, which the French call *shemise*, a straight metallic tube or catheter not quite so long, of three eighths of an inch diameter, and a certain quantity of lint for stuffing (*bourdonnets de charpie*) are necessary for the purpose. The purse is fixed tight round the canula in a notch at about three quarters of an inch from that end of it which is to be passed into the bladder, and open at the opposite extremity. By this contrivance the canula is placed in the centre of the bag, and protrudes through it at one end. The Surgeon, after anointing the exterior of the linen with cerate, passes the canula with the purse drawn close upon it through the wound into the bladder, his left index serving as a conductor; he then introduces the bullets of lint into the bag, one by one, with a com-

mon dressing-forceps, pressing them down with sufficient force to stop the bleeding. Pressure is thus exercised between the lips of the wound, in their whole extent, and the canula which secures an issue to the urine, and which is fixed by means of two rings it presents to a T bandage adjusted to the patient.

Case 6.

Pathiot. Louis Antoine, a military man, forty-six years of age, was admitted at the Hotel-Dieu, March 3rd, 1823.

This patient was of a full habit, and his originally strong consitution had undergone no material change during the campaigns of Prussia, Austria and Poland, in which he served. For upwards of twenty years he had been subject to pain in the kidneys and gravel, and during the last seven had experienced manifest symptoms of stone, the presence of which he first detected one day, by a sudden stop-

page in the flow of urine. He suffered severely from pain at the end of the penis, and had a frequent desire to make water; the slightest shock from walking or riding produced excruciating agony and bloody urine. Frequently, he said, he was obliged to empty his bladder twenty or thirty times in the night, and enjoyed a few minutes ease only when perfectly still. As he had a slight bronchitis on his arrival at the hospital, he was bled and a blister was applied to the arm; he was restricted to a spare diet and care was taken to prepare him well for the operation, which was performed on the morning of the 2nd of April, after evacuations had been procured by the *Ol. Ricini.*

Baron Dupuytren operated by the *Méthode lateralisée;* the prostate was divided with the *lithotome caché*, and in rather less than three quarters of a minute from the commencement of the operation, a roundish stone, about an inch and a quarter in diameter, was extracted. The brilliancy of

the operation elicited a murmur of applause from the spectators, whose number amounted to upwards of three hundred.

An incision had been made in the prostate to the extent of an inch, and as no very great effort was employed, I really did not think danger was much to be apprehended. The patient was put to bed instantly and ordered, Infus. Flor. Aurant et Flor. Filiæ.

In the course of the day, about two pounds of blood flowed from the wound; and it was at last found necessary to stop the hemorrhage by plugging with the *shemise* and canula; this was performed about three in the afternoon.

In the night the patient slept tolerably well, and on the morning of the 3rd, seemed easy. On the 4th, he was exempt from pain and fever, and was considered safe: he appeared notwithstanding much dejected. (A little broth was allowed.) On

the 5th, the canula and plugging, which had been gradually escaping, were completely removed; there was a little head-ache and the skin was dry.

April 6th. These symptoms were more strongly marked. The patient took six grains of calomel, which produced three motions.

April 7th. The head-ache had ceased, the skin was less dry, but the tongue was white and furred. A little of the urine made its way out by the urethra.

April 8th. The patient was evidently struggling against serious mischief; he seemed very anxious and vomited frequently; although the vomiting was succeeded by a gentle diaphoresis, it returned in the evening with shivering and great anxiety. The *Eau de Seltz* was prescribed.

April 9th. Small and frequent pulse; tongue furred and parched; great thirst, and heat in the throat. As the right hypochondrium was rather painful on pressure, forty leeches were applied to it. (Hydrar.

Sub. Muriat. gr. vi.) Several copious evacuations followed this dose of calomel, but no marked amelioration could be obtained, and we began to fear the result of the case. Every possible attention was paid to the patient, who partook plentifully of those diluent drinks most agreeable to himself. April 10th. He seemed much the same. April 11th. Vague, dull and aching pains, were felt in the loins; (Forty leeches were applied to these regions.)

April 12th. The patient complained of great thirst; his sallow countenance, anxious sunk eye, dry skin, wiry pulse and frequent nausea left no doubt in my mind that he was sinking: at times he was delirious. After this period the symptoms varied but little; the delirium continued at intervals, and on the 15th the patient expired.

I have selected this from many instances where lithotomy was followed by hemorrhage, the better to show how little the skill of the operator availeth in such cases.

We were much deceived as to the cause of death, having expected to find suppuration either in the pelvis or elsewhere. At the post-mortem examination, however we discovered nothing to account for it. The only material morbid state bearing at all upon the issue of the case, was observed in the wound, the lips of which were of a dark colour and covered with a little brown pus. There were half a dozen small tubercles in the right lung; but they were in a crude state, and the tissue of the organ immediately around them was perfectly sound; therefore they could not be considered as a cause of death.

The shock communicated to the nervous system in the extraction of the stone, although there was really but little force employed, may have had some influence upon the result; but I think the fatal termination of the case is to be attributed chiefly to the means it was necessary to adopt to stop the hemorrhage.

This is one of several striking examples I have seen, where tubercles existed in a man apparently in a high state of general health, and where they remained undisturbed by inflammation during one of nature's most arduous struggles.

LITHOTOMY BY THE RECTUM.

An operation which at first sight appears much more feasible than lateral lithotomy is cutting by the rectum. This plan founded upon the relative position of the bladder and rectum, and the situation of the latter at the widest part of the pelvic outlet, was recommended a few years ago, by several eminent surgeons; but we are chiefly indebted to Mr. Samson of Paris, if not for its invention, at least for its revival. He proposed two processes; in both the basis of the bladder is laid open by cutting

through the anterior wall of the rectum; but in one, the membranous portion of the urethra and neighbouring part of the prostate are divided; whilst in the other, the incision is made through the posterior part of the prostate and adjoining membranous portion of the floor of the bladder. The latter method must have been admitted upon an old anatomical error, namely, the supposition that a large space exists between the posterior margin of the prostate, and the reflection of the peritonæum; but it was almost as soon abandoned as projected, for, at the time the proposal was made, it was very generally known that this membrane may advance very near if not quite up to the prostate; and had this fact not been known, experience would soon have denounced the process, as establishing between the bladder and peritonæum a direct channel through which the urine would flow as easily as through the wound in the rectum. On this account it is not worth describing.

Not so the other plan, which is well founded, ingenious, and when the stone is large, safer in many respects than lateral lithotomy. A staff, a straight bistouri, a long, narrow, probe-pointed knife, a conductor and forceps are the only instruments necessary to perform it. The patient is placed in the same position as for the lateral operation; an assistant holds the staff steadily on the median line and sustains the scrotum. The operator now introduces the bistouri into the rectum, upon his left index finger previously anointed with cerate, and upon the palmar region of which the flat of the blade is to be closely pressed in order to protect the intestine. When the instrument is fairly beyond the sphincter, he takes the handle in his right hand, and turning the edge towards the scrotum, cuts through the anterior part of this muscle, and the neighbouring portion of the perinæum.

This incision may be carried forwards one inch in front of the anus, so as just to

notch the rectum, and to divide on the median line, the skin, fasciæ and muscular raphe of the perinæum, in the triangular space between this intestine and the bulb of the urethra. By a little dissection the membranous portion of the urethra is exposed; the operator splits it open, and placing the nail of his left index in the groove of the staff directs the end of the probe-pointed knife to the same place. Then, laying hold of the staff with his left hand, whilst the knife is held in the right, he carries both instruments simultaneously towards the cavity of the bladder, into which the knife passes as well as that part of the staff with which it is kept in contact. The next step is to divide the prostate. After removing the staff, the operator cuts through the centre of this gland by drawing the knife from the bladder, towards the perinæum.

The sides of this incision have therefore a vertical direction; but as the knife is withdrawn with its edge nearly parallel to

the rectum, it extends much farther back on the vesical than on the perinæal surface of the prostate, so that in this operation, a sort of valve is formed by the anterior wall of the intestine, which serves to conduct the urine out, and tends to prevent the passage of the fæces into the bladder.

The removal of the stone is to be effected in the same manner as in the lateral operation; but, most Surgeons find a striking difference in the degree of force requisite to remove it in the two methods, for this plain reason—that in the recto-vesical section they are sure to extract it in the proper direction, because it must pass through the rectum, which corresponds to the widest part of the pelvic outlet; whereas, in the other method, they are apt to deviate from the right path, as there is nothing to oblige them to follow it, except their anatomical knowledge. It would certainly be well for every lithotomist to perform the rectal operation once, if it were only to learn the

right way out from the bladder. I am persuaded he would never afterwards drag the stone against the bones, but instinctively carry it round towards the rectum. So should his practice be more successful.

In the operation we have just described, a way is laid open to the bladder through the largest part of the pelvic outlet, and as no large vessels are in danger of being wounded, it does not expose the patient to hemorrhage. Hence, it unites two of the conditions of safe lithotomy; but is it sufficiently unobjectionable in other respects to be entitled to general adoption, and have we here a safe method of cutting for stone? *A priori* one would really have thought so; but experience,—the great test of therapeutics—has put a negative upon this anxious question. No.—Recto-vesical fistula and infiltration of urine render it dangerous, and the former attends it in so consequent a manner, that it is as disastrous, if not so immediately dangerous, as the lateral method. Those who have

watched cases in which this plan was adopted must allow that it leaves a fistula as an almost certain consequence of the operation. The incision will not close; it appears that its lower part constituted by the anterior wall of the rectum, is kept open by the passage of the fæces and irregular motions of the sphincter, and its upper by the flowing of the urine; there is no support for granulations: the cicatrix has nothing to build upon.

This result is so constant, that the recto-vesical section must be viewed rather as the substitution of one disease for another, than as a means of restoring health; and it then becomes a question whether the one substituted, is of such inconsiderable inconvenience as to warrant its introduction into practice? If this kind of Fistula only amounted to an inconvenient and temporary deformity, the project might be entertained; but, unfortunately it is of a very serious nature, and depending as it does entirely upon the physical disposition

of the parts concerned, is almost always beyond the reach of art. In general it is not immediately destructive, but it seldom persists long without impairing even the most robust and vigorous constitution. The continual contact of the urine produces inflammation in the mucous membrane, which, as it creeps along the intestine, occasions great disturbance; giving rise to diarrhea, which cannot be subdued, since the cause cannot be removed, and which, although the patient may resist it for months, or even years, finally exhausts him, either by its own intensity, or by provoking disease in some organ whose intregity is necessary to life. I should think that one half of these cases of fistula terminate fatally. In a very small proportion of them, where the patients happen to be placed under the influence of the most propitious circumstances, a cure may be obtained; but by far the greater portion of those whose general health remains unimpaired by the local injury, must submit to a deformity, which renders life almost unendurable.

I have seen, at least, five or six operations by this method, and in only one case was the cicatrisation of the wound obtained, although they were performed with consummate skill, and great care was taken to make only a mere notch in the rectum.

The other chief accident consecutive to the recto-vesical section, we have stated to be infiltration of urine in the cellular tissue of the pelvis, which, from the quantity of fluid effused, or from the suppuration and sloughing it produces, is almost always a fatal occurrence. It cannot be doubted, that as lithotomy is generally performed, this consequence is not so likely to follow the rectal as the lateral method, because a much less degree of force is employed in the extraction of the stone; nor are any of the consequences we have so much insisted upon, as being inherent to the employment of force, such as—suppuration in the cellular tissue, irremediable injury of the nervous system or inflammation in any internal organ,—much to be be apprehended.

It is therefore undeniable that the life of the impatient is attacked by this method in a manner incomparably less direct than by the lateral operation, as generally performed; and this, we repeat, because the Surgeon, being obliged to remove the foreign body in the proper direction, has much less need to bring his muscular power to the aid of the knife.

In addition to these formidable objections, there is one we ought not to omit mentioning, although it is of considerably less importance, namely, the injury to which it exposes the ejaculatory ducts. As these canals are placed on the median line, close together, they are very likely to come under the edge of the knife, as it passes through the prostate; and although it is not certain that their division ought to constitute a serious objection, it would certainly be as well to avoid them.

When the operation was first proposed, and more particularly after the successful

performance of it by Vacca, it struck me that nothing would be more easy than to spare these canals; and although it would ill become me to recommend my own modification of an operation which, at best, I fear can never be sufficiently safe for general practice, I am not far from thinking, that in addition to the foregoing advantage, it might possibly expose less to recto-vesical fistula. Instead of dividing the prostate on the median line, I should cut about a quarter of an inch to the left of it, so that the operation would more closely resemble the lateral method. To effect this, it would only be necessary to incline the staff to the left side, and to cut into the lateral instead of the central part of the urethra, after dividing the rectum and perinæum a quarter of an inch to the left of the raphe. I think it possible that deviating from the median line might tend to facilitate somewhat the passage of the urine in its natural course by the urethra, and thereby diminish the liability to fistula.

The annexed case is an example of what may be often expected after lithotomy by the rectum.

Rectal Lithotomy.

Case 7th.

Duplessier Antoine, aged 65 years, by trade a Sawyer, was admitted at the Hotel-Dieu, March 31st, 1826. This patient was of a bilioso-sanguineous temperament, and seemed much broken down for his age. For the last two years, he said he had been afflicted with pain in the glans penis, difficulty in making water, which was sometimes bloody, and a sense of weight in the hypogastrium.

He was sounded on the day of his admission, and it was ascertained that his bladder contained a large stone. (Warm bath; Mucilagenous drinks; Spare diet.)

April 10th. Lithotrity was attempted;

but the operation was then little understood, and as the stone was large, it failed. This attempt lasted twenty minutes and was followed by inflammatory symptoms which were not completely subdued till the end of April. On the 13th of May the patient was tolerably well, and Lithotomy was performed by the rectum ; Mr. Sanson operated according to his own plan.

The man was placed in the usual position ; a staff was introduced into the bladder, and held there by an assistant. The operator then passed a straight knife placed flat on his left fore finger into the rectum, just beyond the sphincter ani ; taking the knife in his right hand, he now turned its edge forwards and carried it through the anterior part of the sphincter and adjacent portion of the perinæum towards the staff, on the median line. The left finger being passed into the upper angle of the wound, was used to direct the knife to the groove of the staff, which, by another incision, was fairly laid bare, and now served to conduct

the knife into the bladder. The prostate was divided by drawing the knife very obliquely forwards and towards the rectum, so that the coats of the gut, being divided to a very limited extent, might serve as a valve to prevent the passage of the fæces into the bladder.

The stone was immediately laid hold of with a forceps, and extracted without the least force; it was an inch and three quarters in length, and measured about an inch in its lesser diameters. The operation was completed in a masterly style, and with scarce any pain to the patient, in four or five minutes. Of course there was no bleeding. (Antispasmodic Mixture; Poultices to the hypogastrium.)

The patient passed the day in a state of quietude and was somewhat drowsy. May 14th, local mischief was indicated by shivering and general uneasiness. (Fifteen leeches were applied above the pubes.) May 15th, fever; restlesness; head-ache.

(Enema. Purg. Syrup. Papaver ʒvi.) May 16th, 17th, and 18th. The patient had regular motions and seemed free from acute pain; but there was something cramped and unnatural in his countenance.

This state was succeeded by general debility, dry skin, small pulse and constant thirst; all the urine passed off by the wound. May 25th. Nothing could rouse the patient from the deep prostration in which he lay: there was no local pain, but the general state indicated suppuration somewhere. About the 2nd of June, the patient became extremely weak; the skin of the back and gluteal regions began to redden; the tongue was dry, the eye dull, the pulse small and wiry, the skin dry and hot. These symptoms increased in intensity till the 13th, when the patient expired.

Post-mortem Examination.

Excoriations existed in the skin covering the prominent parts of the posterior

region of the body. Most extensive disorder was found in the cavity of the peritonæum and in the pelvis.—The peritonæum contained two pints of a brownish opaque fluid, in which some albuminous flakes were mixed. In the hypogastric region the intestines adhered pretty firmly to one another; and several ounces of pus gushed from the pelvis when it was attempted to examine this region by separating the agglutinated parts from above downwards. Between the rectum and bladder, the peritonæum could not be distinguished from the tissues beneath it; all being converted into a putredinous mass of sloughs and pus down to the wound, it was impossible to say, whether these had been separately the seat of inflammation, or whether the peritonæum had been destroyed by the gradual progress of the disorder. Laterally the peritonæum was entire, probably on account of the greater strength of the fascia of the pelvis in this direction.

The bladder was contracted and pre-

sented no material alteration; its mucous membrane was of rather a dark grey colour. The opening made for the extraction of the stone extended from the back part of the bulb of the urethra to the posterior edge of the prostate, dividing this gland and the inferior part of the canal into two equilateral halves. It had the appearance of a sloughing wound; its lips were grey, softish and wide apart. This incision corresponded to another, about an inch in extent, in the anterior wall of the rectum, which being less prolonged posteriorly than the opening in the bladder, formed to the latter a kind of valve disposed so as to prevent, to a certain degree, the passage of the fæces into it. The line bounding the incision behind was nearly parallel to the anterior wall of the rectum. From the sloughing state of the wound, it was impossible to detect the ejaculatory ducts which were probably destroyed.

What remained of the cellular tissue

of the pelvis was transformed into flaps and shreds of sloughing, putredinous substance soaked in a large quantity of whitish pus which extended into the abdomen between the bladder and rectum, where, on the right side, all the disorder in the abdomen communicated with the incisions. It was in this place that the suppuration seemed to have extended progressively towards the peritonæum, so as to have destroyed at last the fascia and this membrane, and thus to have made its way into the abdominal cavity. The fæcal matter might, at one time, have passed into this cavity, so as to colour the liquid it contained, and might afterwards have been blocked out by the adhesive inflammation, by which the intestines were agglutinated in the pelvis.

The kidneys were soft and of a brown colour, espescially the right; the lining membrane of their pelves and of the ureters was of a slate-grey colour. In the other organs there were only traces of old age.

The heart was large and flabby, and the aorta presented numerous patches of ossification and cartilaginous transformations.

This is a good example of the danger of a large incision: the stone was extracted with ease; the patient suffered little; but the urine came immediately in contact with the fascia of the pelvis and worked its way to the peritonæum, destroying all the cellular tissue, and producing besides fatal peritonitis. I quote this case of median, longitudinal division of the prostate, more especially in order to show that upon whatever plan the opening is made, if it be considerable, the patient must be exposed to this incurable and frightful accident.

HIGH OPERATION

OR

LITHOTOMY ABOVE THE PUBES.

To elude the difficulties which oppose access to the bladder through the inferior aperture of the pelvis, it is not astonishing, that at a very early period, Surgeons should have tried opening it through the short, clear and direct way of the linea alba, above the pubes. Here the aperture is large, and the parts to be traversed are of a simple structure: no important vessels are exposed to the knife, nor is there much hazard of wounding an intestine. But though this plan is exempt from the danger of hemorrhage and fistula, and

affords a tolerably spacious passage for extracting the stone, there is the same insuperable objection to it, which renders the other methods we have examined so truly perilous. One great obstacle to successful supra-pubic lithotomy is still infiltration of urine in the cellular tissue; but we shall return to the consideration of this and another serious objection to the operation, after sketching the best mode of performing it.

Several methods of cutting above the pubes have been described; but of these it may be said, (as of many other surgical operations proposed for one and the same disease,) one only is good. The instruments requisite are a common straight bistouri; a probe-pointed knife; and forceps. No matter in what state the bladder may be, an Anatomist will require no other guide than his finger to direct him to it; as, however, it is most easily reached, when full, it should be made to contain as much fluid as possible at the time of the operation.

If the patient cannot retain urine enough, a certain quantity of warm water made slightly mucilaginous or even sedative may be injected, and its escape partially if not wholly prevented by pressure on the urethra, which should be exercised by an assistant. He should be placed horizontally with his legs a little bent, and supported by pillows. The operator, who is to stand on the left side, feels for the symphysis pubes, and makes an incision about two inches and a half in extent from it towards the umbilicus; dividing, exactly on the median line, all the soft parts down to the linea alba, (except superiorly, where the incision may present a slanting termination,) he is to puncture the latter close to the symphysis, and then to enlarge the perforation upwards, sufficiently to admit his finger with a probe-pointed knife; taking care not to carry the instrument one single hair's breadth beyond the cellular tissue which separates the fascia transversalis from the peritonæum, and in which the finger is to be passed to detach this mem-

brane from the wall of the abdomen. In conducting this part of the operation he must proceed slowly, carrying his finger from below upwards. It is of the utmost importance to confine the separation of the peritonæum as much as possible to the median line; for, the more it is detached from side to side, the greater will be the danger of exposing the patient to infiltration of urine. As the peritonæum is pushed back, the incision in the linea alba is to be enlarged; and when there is sufficient space for the extraction of the calculus, the same process must be repeated, with the same precaution, at the top of the anterior wall of the bladder. To find this organ the Surgeon must not trust entirely to the peritonæum, but rather depend on the symphysis pubis behind which it is situated, and he will be fortunate if he can reach it without disturbing the cellular tissue which unites it to the symphysis; but should it be contracted upon the stone so that he cannot elevate it by an injection, he must pass his finger down to it. When

the bladder is distinctly felt, the peritonæal covering is to be detached upwards by the finger passed between the latter and the muscular coat, to an extent sufficient for the passage of the calculus; and here it will be found, that great pains are required to clear the way for an opening in the bladder an inch and a half long. This opening is to be made and enlarged precisely in the same manner as that in the linea alba, except that the peritonæal coat must be first removed in the whole extent of the incision before the puncture is made. Thus, the left index should be placed edgewise on the symphysis, at the lower part of the wound in the linea alba, to guide the knife to the corresponding part of the bladder, whilst the middle finger sustains and protects the peritonæum above, and indicates the superior limit of the incision to be made in the bladder. The operator punctures this organ on the index; and, carrying the knife upwards, divides from within outwards its anterior wall, up to the part upon

which his middle finger rests; taking care to incline the edge of the knife, and not to pass it too far in, in order that there may be no danger of wounding the opposite side. The fingers should be passed into the opening in the same position, so as to sustain the parts and direct the forceps. When the calculus is seized, it must be drawn first in a direction parallel to the posterior surface of the symphysis, and then made to revolve forwards through the external opening. After the operation, a strip of linen three quarters of an inch wide should be left with one end in the bladder; the other hanging out of the external wound, as a syphon to conduct the urine away. This, with a pledget of lint supported by a belt, is all the dressing required; but in renewing the lint as often as it becomes wet, care must be taken not to disturb the strip of linen.

When we consider that in this operation it is the moveable part of the bladder which is interested, and that the opening

is made near its summit, we shall at once conclude that infiltration of urine in the cellular tissue must very often ensue. This tissue is loose and abundant at the most depending part of the wound, precisely where the urine will of necessity be directed by its own weight; consequently, infiltration of this fluid is almost inevitable. Again, as the bladder varies in size, and therefore its moveable part in position, according to the quantity of urine it contains and the degree of its contraction, the relation which the incision made in it bears to the external opening must be liable to vary also; and thus, from these wounds ceasing to correspond, the urine will be impeded in its egress and tend to pass into the neighbouring cellular tissue.

From these circumstances, infiltration of urine follows the high operation more frequently than it occurs after the other plans of Lithotomy; and were there no other, this accident would be alone sufficient to render it more fatal than they.

The other strong objection we have to urge against supra-pubic Lithotomy is the occurrence of peritonitis, which follows much more frequently this than any other mode of operating. Detaching the peritonæum from the parts to which it adheres as a lining is no trifling affair. In fact, the membrane receives direct injury; for, to disturb its close connexions and destroy its natural adhesions, in the manner required, is certainly to injure, and most seriously too, at least one surface of it. Not unfrequently this membrane has been torn or cut through in the operation, either from the difficulty experienced in separating it from the subjacent parts, or from ignorance of the fact we claim as our own discovery, that the bladder rises in the cavity of the peritonæum and not between it and the walls of the abdomen. But although a knowledge of the anatomical disposition on which this depends, will preserve the Surgeon from the danger of cutting into the peritonæum and establishing a direct communication between the

cavity of the bladder and that of the abdomen, the process of peeling off the membrane must, in the majority of cases, subject the patient to peritonitis of a kind which is generally fatal.

Not to mention many other objections, then, the occurrence of infiltration of urine and of peritonitis places the high operation quite out of practice, except in cases where the stone is too voluminous to admit of extraction by the perinæum; and for these we shall have to suggest something in the course of this work, which we trust, will be found far superior to it.

LITHOTRITY.

We have examined the best modes of performing Lithotomy, and pointed out the chief circumstances which render them all more or less dangerous. Let us now consider the operation with which it is our object to compare them—Lithotrity.

Lithotrity consists in the reduction of calculi to powder, or fragments sufficiently small to pass through the urethra, by means of instruments introduced down this canal into the bladder. To accomplish this or some very similar object, instruments have been invented and recommended by Messrs. Elderton, Amussat, Leroy d'Etiolles, and Heurteloup. These gentlemen were preceded by Mr. Grui-

thuisen in the invention of an instrument for drilling a hole in calculi, but with a view, it is believed, of dissolving them by some chemical agents; and it is well worthy of remark, that long before their praiseworthy attempts, two non-medical persons, a monk of Citeaux and Col. Martin, not only devised, but actually cured themselves of stone by means somewhat similar to those now adopted in Lithotrity. The idea of breaking and pulverizing a stone in the bladder seems first to have originated with the monk, but it is not likely Col. Martin borrowed it from him, since he employed different means. I think there is no probability of plagiarism, either on his part or that of the practitioners we have just named. It would be a difficult task to assign to each of these the degree of merit due to him; suffice it to say, they have all well deserved of mankind. Mr. Gruithuisen, who published in 1813, appears to have been the first to devise any thing like scientific or methodical means for acting upon a stone in the bladder by tri-

turation. In 1819, our countryman, Mr. Elderton,* conceived the idea of Lithotrity, and invented ingenious instruments for the operation; but here he stopped. Mons. Leroy had the same idea in 1822; he constructed and made known instruments which are now in use. About the same time, Mons. Civiale succeeded in the same object; and to him was reserved the good fortune and high privilege of first employing Lithotrity with method and success upon the living subject; he is still a very successful operator. Baron Heurteloup is now quite as successful and scientific a lithotritist, and to him the world is indebted for the invention of instruments more ingenious, and in many respects, more perfect than those known before his valuable labours. The merit of laying down the principles of Lithotrity more comprehensively and more perfectly than any

* To this gentleman, who resides at Northampton, we are also indebted for other inventions of great importance in surgical operations.

other person, belongs also to him; and he shares likewise the honour of its introduction into Great Britain, to which, with my skilful friend Mr. Costello, I hope I have endeavoured to contribute.

The instruments most in use are the three-branched forceps of Messrs. Leroy and Civiale, and the four-branched forceps, the assisting forceps and the shell-breaker of Baron Heurteloup.* It may be necessary to remind the reader of their construction; but for minute descriptions of them we refer to the works of Leroy, Civiale, and Heurteloup. The three-branched forceps termed Lithoprione, Lithotriteur, and (less appropriately) Pierce-pierre, is composed of two tubes sliding one within the other, and of perforators, borers, and excavators. Its external tube is about eleven inches long, and three eighths of an inch in diameter; at its extra-

* See the plates.

vesical end, it has a solid part which serves as well for a handle as for other purposes. The internal tube is seventeen inches in length, and has a similar solid part at the same end, where it presents a scale of inches, so that its position with respect to the external one, can be appreciated to a nicety; at the other end, it is split to the extent of three inches, into three curved branches which diverge by their own elasticity, and being of unequal length, occupy when closed little more than the diameter of the external tube, to which they then form a smooth extremity projecting beyond it about an inch. To open the instrument, it is necessary to make this extremity of the internal tube project further beyond the external one, either by drawing the latter back or pushing the former forwards; contrary movements will of course close it upon a calculus, upon the borer or upon itself. The borer passes down the internal tube; it is a steel wire formed into a saw or file at one end, and marked with inches at the other, where it

receives a pulley to be adapted to a drill bow. In the solid part of the external tube there is a stop-screw for fixing the internal one at any given projection; and there is also a hole in it, to allow of water being injected into the bladder during the operation.

The four-branched instrument is constructed upon a similar plan, except that its branches can be made to advance and recede within the external tube, either separately or otherwise; and when open, it admits of the *Pince-servante*, (which is a very delicately constructed, three-branched instrument,) being substituted for the borer or excavator, and used to bring the stone within the branches.

The shell-breaker (*Brise-coque*) is very strong; it is composed of a tube and two separate branches: the latter slide in the tube, opening like a forceps when protruded a certain distance from its vesical extremity, and closing when they are made

to recede either upon themselves or upon a calculus. But, by a very ingenious contrivance, these branches, the ends of which are beset with teeth, can also be made to move longitudinally, to and fro, upon each other, so as to exercise great power of attrition, as well as of pressure, upon any thing placed between them, like the stones of a corn mill.

In Lithotrity one or more of the following powers must be had recourse to; namely,—pressure, perforation, excavation, concentric pulverization, percussion; and, according to the direct means required to destroy the calculus, the operator must use, alone or in combination, a drill, an excavator, a concentric saw, or a percussor, which are of course all employed with the three and four-branched forceps. The excavators and saws consist chiefly of a strong tube terminated at the vesical extremity by a saw-shaped blade, which is opened or shut by means of a central wire.

The percussor is a steel rod having a stop to limit its action.

We see that the tubes, or principal and more complicated pieces of mechanism in the three and four-branched forceps, are more especially subservient to the purposes of seizing and retaining the stone; so that the means of reducing it to fragments or powder belong chiefly to the borer. They are not however exclusively intended to grasp and hold the calculus, as they include one of the powers employed in Lithotrity to destroy it; namely, pressure, which is exercised by the branches.

The other Lithotritic powers, attrition, perforation, excavation, percussion, concentric pulverization, are almost all derived from the central piece of the apparatus. The shell breaker, however, which combines pressure and attrition, has no central piece, and these forces reside in its tube and branches. The powers or forces we have just enumerated are metho-

dically combined in Lithotrity, and constitute, when brought into action, what may be termed operative processes. Thus, all calculi are reduced by one of the following processes. 1. Attrition and pressure. 2. Perforation and pressure. 3. Perforation, excavation and pressure, with or without percussion. 4. Concentric pulverization.

Some calculi are sufficiently small and soft to yield to the pressure and attrition exercised upon them between the drill and the branches of the three-branched forceps; such are many of those composed of Uric acid and even of the phosphates. Calculi more voluminous, but of the same composition, may require to be perforated in one or in several places, before they can be crushed to fragments; and those still harder, composed of oxalate of lime, may require, either to be completely excavated, or to be ground away by concentric pulverization. It is therefore according to the volume, chemical composition, and form of the stone, that the process for

destroying it is selected; and we cannot repeat too often, how highly essential it is to the success of the operation, that these points of the diognosis be correctly ascertained. When they are known, the operator will have no difficulty in selecting the most fit instruments. How these act, may be learned from a simple inspection of their construction; we shall, however, farther shew to what cases each of them is adapted, by a brief description of the method of using them in the chief varieties of stone.

In the present state of science, Lithotrity is scarcely applicable when the foreign body exceeds an inch and a half in two of its diameters. The most simple case, perhaps, is that where the stone is less than an inch in two of its diameters, and composed of the phosphates or of uric acid. It is to be met by the three-branched instrument and Civiale's drill. The Surgeon having inclosed the calculus in the branches of the forceps and fixed the tubes

by means of the stop-screw, will succeed in crushing it to pieces by subjecting it to the action of the drill, either with the bow or with his hand; with the latter he presses and triturates it between the claws of the forceps and the drill which he rotates as he moves it forward. In the second case, where the stone is of the same composition but of a larger size, the operator, after having tried to break it down with his hand, as in the former case, must proceed, if he has been unsuccessful, to perforate it once regularly by means of the bow; he should then be able to turn the calculus so as to present another part of its surface to the action of the drill, with which another perforation is to be made; and this process is to be repeated till the calculus is so weakened that it may be crushed to pieces. This is Civiale's plan. In the third case, that is, when the stone is composed of oxalate of lime, M. Civiale has recourse to the same method, namely, repeated perforations; but I fear with little success. Baron Heurteloup, on the con-

trary, recommends in such cases, excavation or grinding away the interior of the calculus till nothing remains of it but a mere shell, which is to be broken with a percussor, and then destroyed, fragment after fragment, by means of the shell-breaker. He proceeds thus:—The four-branched instrument is passed into, and fixed open at the neck of the bladder; he then introduces down its centre the assisting forceps and searches for the stone, which, having found, he seizes and draws into the branches of the *Pince-maitresse.** Having withdrawn the assisting instrument, he fixes the calculus in the branches of the *Pince-maitresse* by passing the headed-one over it, and then drawing and fixing them tight, separately, as well as simultaneously. After this, he proceeds to perforate it to the depth of about three fourths of its diameter; then, substituting an excavator

* The four-branched instrument is so termed; it is also named *Pince à Forceps.*

for the drill, he works out its interior and reduces it to a hollow ball. The excavator is to be worked to and fro, and the blade must be expanded a little after each time that it passes through the whole extent of the perforation. Should a hole be made through any part of the shell, the process must be stopped; otherwise the instrument might be engaged therein and broken. When the excavating has been carried as far as possible, the excavator is to be withdrawn; the stone is then to be loosened in the branches grasping it, and turned by means of the assisting forceps, so that a solid part present itself to the axis of the tubes. There it is to be fixed again; and the operator, striking with a hammer a percussor substituted for the excavator, breaks it into fragments which are to be separately destroyed with the shell-breaker. We believe this plan is recommended by Baron Heurteloup wherever the stone is large and spherical, whatever may be its chemical composition.

For the treatment of this kind of calculus, it has been proposed by Mons. Meyrieux and others, to adopt the plan of concentric pulverization. When the stone is safely lodged in the three or four-branched forceps, the Surgeon introduces the instrument which we have called a concentric saw, and expands the blade to a degree at which it will turn safely, without coming in contact with the branches. He then makes use of the bow, and grinds away the surface of the calculus till it becomes loose in the forceps. After withdrawing the saw, he fixes the stone again, and continues the process till he has reduced it sufficiently to be able to destroy it by pressure and attrition.

Lastly. When the stone is of such a flat shape that it cannot be held with the three or four-branched forceps, it must be attacked with the shell-breaker. The operator searches for it with this instrument, and having grasped it, proceeds to break it to fragments by lateral motions communi-

cated to the lever, which the handle of the shell-breaker represents.

In all cases, the fragments, like entire calculi, are to be submitted to the process which their volume, shape and chemical composition comport.

Some attempts have been lately made by Baron Heurteloup to destroy calculi by percussion alone. The instrument, which he has invented and used with some success, resembles, when closed, a large, solid, curved sound. It is composed of an internal or superior, and an external or inferior piece of steel; and the former is included and made to slide, to and fro, in a deep groove of the latter; so that their curved portions, which are beset with teeth, strike one against the other, and abutting, constitute a kind of vice for seizing and acting upon the stone. At the extra-vesical extremity of the instrument the internal piece projects, and is so fashioned that it may be struck with a hammer, the weight

of which is proportionate to the force that may be employed with safety; it has, also, a stop to prevent its being driven with too much violence against the external one, which is made with a square head to fix immoveably in the hold fast of the bed. It is proposed to use this instrument in the following manner:—The operator passes it down the urethra into the bladder closed, and, after finding the calculus, opens it by drawing back the internal piece. He then endeavours to engage the foreign body between the blades or curved parts of the instrument, and having succeeded, he is to fix the square head of the external piece firmly to the bed. At this time, the bladder, being filled with water, is protected from the shock that would otherwise result from the process. The Surgeon now strikes smartly, with a hammer, the cap-shaped, projecting end of the internal piece, which thus becomes a percussor, until the stone yields.

Before withdrawing the instrument he

must be careful to close it completely, as the blades, if left apart, would obviously endanger the urethra. The fragments are to be disposed of, as their volume, form, and density may indicate.

An instrument, of which the above appears to be a modification, was constructed some years ago, by Mr. Weiss; except that its internal piece is made to advance and recede by means of a screw, so that the stone is acted upon by pressure instead of percussion. With these instruments, in their present form, the operator must experience great difficulty in laying hold of the stone; in some cases, however, where the foreign body is soft and of a flat shape, they may be used with advantage.

As in most surgical diseases, skill of quite as high an order is necessary to prepare the patient for, as to perform the operation. Since the preparatory and adjutory treatment must be modified to meet the circumstances of each particular case, it is

not easy to lay down more than general rules. If there be one truth, which, more than another, we wish to impress on the Surgeon with regard to Lithotrity, it is—that he must prepare the patient as carefully, as methodically and as maturely as before performing Lithotomy, amputation of a limb, or the most serious operation. In adapting the preparatory treatment to each case, particular attention must be paid to the age and constitution of the patient—the state of the urinary apparatus—the duration of the disease—the form, volume, and chemical composition of the stone. All the functions should be brought to as perfect a state as the case will admit of, by dietetic and medicinal means. A proper plan of diet must frequently be persevered in for months prior to the operation. General and local bleeding, the warm bath, injections, the use of alcalis or acids must be had recourse to, and combined methodically with such other means as may be necessary to induce a permanent calm of body and mind. The choice of these

means will be found of equal importance to expertness in the mechanical part of Lithotrity. While the vascular system is in a state of plenitude the operation must never be attempted; if it were, the irritation inseparable from it would be followed by severe if not by fatal inflammation of the whole urinary apparatus. According, then, to the strength of the patient, blood must be removed, first, by the lancet, from the arm, and, one or two days afterwards, by leeches, from the lumbar and iliac regions. As soon as the equilibrium of the circulation, temporarily interrupted by the subtraction of blood, is re-established, the nervous system will be found in a state of comparative quietude, however violent the local symptoms may have been. A few warm baths, appropriately taken, will tend much to confirm this desirable state; but, be it observed, the patient must not remain in the water, (the temperature of which should be increased at the end of the time,) more than eight or ten minutes; and on quitting it, he must be instantly put into

warm sheets and rubbed dry. There should be no stress whatever upon the digestive organs: the food should be simple, light, well prepared, well masticated, and taken in small quantities. Every complex dish must be abstained from, and fluids should not be mixed with solids, in the stomach, more than is absolutely necessary. The genital system must, in general, be kept in a state of inaction. The action of the urinary organs must be aided and eased by soft aqueous fluids taken between meals. Nothing that can afford peace of mind and courage to the patient should be neglected. It will be well, however, to let him know he has a most painful, though not a dangerous operation to undergo, that he may prepare himself to bear it; for, in many cases, the pain is most excruciating, and can be resisted only by the most fixed and resolute determination. These means will all tend to lessen the irritability of the bladder, and enable it to contain an increased quantity of fluid, without contracting upon it. Whatever may conduce to

this end must be employed. Injecting the bladder with warm water made slightly mucilaginous or sedative is of the greatest use. The injection should be continued daily, till the irritability be allayed: the object is not to operate a forced dilatation of the bladder, but, by lulling its excessive sensibility, to render it susceptible of containing the quantity of water necessary for the operation It is well known, that great operations are most successful when performed while the different organs are in a state of semi-repose; that the nervous system is at rest; and that there is a kind of general *relachement* of the arterial and muscular systems. This state is particularly essential to the success of Lithotrity, which should be performed, only when the patient feels himself comparatively well; when the skin is natural, the pulse slow and steady, the digestion easy; when the spirits are good and all the functions brought as near regularity as possible.

But, above all things, let the Surgeon

ascertain as accurately as possible the chemical composition, volume, and form of the stone; for, these particulars of the diagnosis indicate, in a great degree, the special steps to be adopted in the operation, and consequently, the instruments which are to be employed in it. Calculi composed of uric acid yield more readily to the action of the instruments than any others; after these, the phosphate-calculi are most easily destroyed; and lastly, those composed of oxalate of lime are the most difficult of comminution.

In the operation of Lithotrity the position of the patient is of very great importance; the object to be aimed at, in placing him, is, that the back part of the floor of the bladder should become the most depending part of the body, so that, when obeying its own gravity, the stone may settle there. To effect this, Baron Heurteloup has constructed a moveable bed, on which the pelvis can be raised to any height required; it has, also, a contrivance

for fixing the instrument when the stone is grasped, so that neither of these press on any part of the bladder, if the patient remain perfectly motionless. It is attended, however, with some danger; for, were he to start in any direction, the bladder would necessarily be forced against the end of the instrument, which, being fixed, might possibly cause severe contusion, or even laceration. We can avail ourselves of the advantage of this fixed vice, only when there is not sufficient pain to cause any sudden motion, against which we must be careful to warn the patient. This bed is of immense use, and ought to be employed wherever it can be procured. Mons. Civiale contents himself with placing a certain number of pillows under the pelvis of the patient, whom he directs to lie lengthwise on the edge of a common bed. In all cases, the body of the patient should be carefully protected from the cold air.

The next thing to be considered is the quantity of fluid contained in the bladder.

We repeat, the just measure is as much as it can hold without contracting to expel it. When there is not enough in it, warm water containing a small quantity of vegetable mucilage, and, sometimes, of the extract of opium, is to be gradually injected, through a catheter introduced into the bladder for the purpose. In almost all cases, it will be found advantageous to use the injection: it may possibly be dispensed with, however, where the bladder is voluminous, its sensibility obtuse and its contractility languid. As soon as this object is accomplished the catheter must be withdrawn, unless used to move the calculus. According to his opinion respecting the shape, volume and density of the stone, the Surgeon will choose the instruments. We will suppose it to be an inch and a half in two of its diameters, tolerably spherical, and composed of uric acid and the mixed phosphates; here we should prefer the three-branched instrument. After being well greased, it is to be passed into the

bladder; in introducing it, the urethra should be made to form, as nearly as possible, a continued straight line with the floor of the organ, at the back part of which the stone will lie, or must be made to lie by raising the pelvis. The instrument will pass directly up to this place, where the operator will endeavour to strike the calculus with its end, by gently moving it to and fro, from before backwards, always proceeding methodically from one side of the bladder to the other. In cases where the stone evades research, it will be necessary for the patient to change his position; and I would advise postponing the operation, rather than the bladder should be two much fatigued by sounding: the state of this organ must always be respected. When the stone is discovered, the operator endeavours to place the end of the instrument directly opposite its centre, in doing which he will obtain a pretty correct notion of its volume; he is then to draw the forceps about a quarter of an inch from the calculus, so that when its branches

expand, they may not disturb its position. Before opening the instrument, he must take care that one of its branches be turned upwards, in order that when expanded, the other two may lie flat on the floor of the bladder to receive the stone. To open it, he draws the external tube towards him; when open, if it is depressed on the floor of the bladder, the stone will probably fall within its branches, where it may be instantly recognised with the borer, which must be carefully kept in its proper place. Should it be found, however, that the branches do not enclose the stone, the Surgeon is to carry them on to it, by moving the instrument towards the posterior wall of the bladder. When he has succeeded, he closes the instrument on the calculus, by moving the external tube from him upon the internal one; but, prior to fixing it firmly, or using any thing like force, he must be certain, by being able to move it slightly without occasioning much pain, that no part of the bladder is caught. In these steps, the

Surgeon will ascertain by the scale, the size of the calculus, and will also be furnished with fresh data as to the best means of reducing it to fragments and powder; which forms the second part of the operation.

This, (supposing concentric pulverization inapplicable,) is to be commenced with a drill, which being pressed and rotated against the stone, will communicate an idea of its density, in relation to which, it should be selected; and the pulley must be placed, so that it cannot go through, against the coats of the bladder. Before using the bow, the Surgeon places the end of the drill in a kind of vice, which serves at the same time to keep it steady, and by means of a spring, to exercise on it a due degree of pressure.

By practising with a drill and bow out of the bladder, the operator will acquire more skill in using them, than by any directions that could be given to him. When the drill is through, or nearly through the

stone, it is to be withdrawn, and as the Surgeon will know the density of the latter, he will now be better able to decide whether he ought to proceed farther by fresh perforation or by excavation; whilst the state of the patient will indicate whether or not the future steps of the operation should be deferred till another day. If no delay be necessary, and the Surgeon decide on employing perforation, the next step is to turn another part of the stone to the axis of the instrument, either by loosening the branches and moving it round in them with the borer or the assisting forceps, or by dropping it in the bladder and seizing it in another direction. In either case, he turns the stop-screw, and moves the external tube towards him; the stone will then be loose, but within the branches. He should always endeavour to turn it, if possible, without the pain and difficulty of dropping it to seize again. When the drill indicates that a fresh part of the calculus is turned to it, the Surgeon is to close the instrument by moving the external

tube from him, and to fix it with the stop-screw. Another perforation is then to be effected.

This process of turning and perforating is to be repeated, till, at last, the stone crumble to pieces under the pressure of the branches which enclose it. We repeat, what intervals are to be allowed to elapse between the different steps of the operation, the state of the patient must determine. When the calculus is reduced to fragments, those which are sufficiently small will pass off with the urine; and those which are not, must each be seized with the instrument and subjected to attrition, between the branches of the forceps and the drill; the Surgeon proceeding as if he had to do with a number of small calculi, and observing minutely all the rules to be followed in destroying these. During the process, an injection should be ready, as it is necessary to replace the urine, which in many cases, escapes, by a fresh supply of fluid. This, and other means for prevent-

ing and allaying irritation, must be administered during the whole of the treatment. Whenever the bladder is much irritated, the operation must be interrupted: the state of this organ should, above all things, fix the Surgeon's attention. Frequently, fragments will stick in the urethra, and when they cannot be washed away by injections, they must be disengaged with the assisting forceps, or with Sir A. Cooper's instrument. Should any of the larger fragments be of a flat shape, and difficult to seize with the three-branched instrument, they must be destroyed with the shell-breaker.

As the manual part of the operation is nearly the same for all the instruments, it will not be necessary to give a detailed description of the manner of using them. The three-branched forceps is by far the most simple, the least liable to fracture, and adapted to the greatest number of cases; but it is not well suited to seize the stone, and is more likely to pinch the

bladder than the four-branched instrument. But the latter, which is so much better for seizing the calculus with safety and precision, is, unfortunately, weak in proportion to its more complicate and delicate construction, and not free from the danger of breaking in the bladder. It ought to be preferred wherever the stone is large, difficult to catch, and susceptible of being destroyed by concentric pulverization; and, in some cases, where the plan by excavation is adopted. In using it, the Surgeon must take care to open it with the headed branch turned upwards. This branch is to be drawn back between the others, to keep them well apart at the neck of the bladder, whilst the assisting forceps is passed down to bring into them the calculus, over which it is then to be moved out.

By drawing back all the branches, first together, and then one by one, the stone is firmly grasped, and the Surgeon may proceed to destroy it; recollecting always, that as they are weak and delicate, too

much stress must not be put upon them. He should endeavour to avoid drawing the forceps forcibly towards the urethra; for, all these instruments, when open, represent a cone, the summit of which being turned towards the urethra, tends to contuse the parts when pulled in this direction with any degree of force.

The plan of destroying calculi by concentric pulverization, that is, by grinding away successive layers from the surface, has not been much adopted, the means of effecting it being, as yet, very imperfect. Were they efficient it would be far more applicable than any other, to cases where the stone is hard as well as voluminous; and preferable, also, where it is of large size though not of great density. Those who recommend this plan, after seizing the calculus as we have already explained, in the three or four-branched forceps, attack it with a concentric saw formed at the end of a steel rod which is rotated with a bow. The Surgeon expands the blade according

to the size of the stone, so that by each rotation, a layer is removed from the whole circumference of that part of the foreign body, which is turned towards the tubes. After some time the calculus will become loose, and require to be fixed again; it is thus to be acted upon, till reduced to such a size that it will yield to the attrition exercised upon it by a drill and the branches of the three-branched forceps. The Surgeon must use the saw with great precaution, taking care not to expand the blade too far, which otherwise would be broken against the branches of the forceps.

In using the shell-breaker, the Surgeon must be particularly careful, in his attempts to grasp the stone, not to close the branches too firmly before ascertaining well that the instrument is perfectly free in the bladder, and that no part of this organ is enclosed in it. He must also muster all his patience, as it is very difficult to lay hold of a stone with a forceps composed of two blades, which are compara-

tively narrow and have but little bite. The great point is to pass one blade under the centre of the calculus; and the great danger to be avoided is pinching the bladder. The shell-breaker is undoubtedly an excellent instrument, and without it many cases of stone must have been abandoned to Lithotomy, which are now treated by Lithotrity: it is the only one of the Lithotritic instruments that can be used with success, where the calculus is large and flat. Like all of them, however, it is liable to break in the bladder, when too much stress is put upon the branches; and, as there is great difficulty in seizing the stone, and great danger of pinching the bladder with it, the three-branched instrument ought to be preferred, wherever it can be used effectually.

A few remarks will now be necessary upon the preference to be given to any particular plan of Lithotrity, or to any particular instruments, in the treatment of the principal varieties of stone. We

have no hesitation in stating, that there is only one case in which the four-branched instrument ought to be preferred, namely, that where the calculus is composed chiefly of oxalate of lime, and very hard. In all other cases, which form by far the greatest number, we prefer the three-branched instrument and drill, that is, the treatment by successive perforation, which, in the present state of science, appears much more safe than any other. The instrument with which it has been proposed to destroy the stone by excavation, is much more liable to break than the three-branched forceps; and that invented to act by concentric pulverization is open to the same objection, besides being inadequate to the purpose for which it was intended. Most assuredly we should recommend the four-branched instrument for the treatment of all large round stones, of whatever composition, if excavation, or still more, if concentric pulverization could be employed with efficacy and safety; but, we contend they cannot: the excavator

has not yet been, and we fear, can never be made of sufficient strength; and even barring this difficulty, it is almost impossible to reduce a stone, in the manner proposed, to so thin a shell that it may be broken by percussion, unless it can be seized with the percussor-forceps. When an excavator shall be made so strong that there be but very little risk of its breaking, and so well as to reduce a stone to a mere shell, it will deserve to be adopted with the four-branched forceps, in preference to the drill and the three-branched instrument, wherever the calculus is large and round. But, we are of opinion that the most rational and safe plan of all for destroying calculi, would be that of concentric pulverization, were the saw sufficiently perfect to carry it into effect. Some of the strongest objections to Lithotrity would then be obviated: there would be no rough fragments left to irritate the bladder; and, as the instrument would leave the surface of the stone smooth, the operation, every step of which would bring

relief to the patient, might be interrupted and deferred, at any time, with impunity. Had we such a saw it would be right to use it with the four-branched forceps, in all cases where the stone is not flat, but more particularly in those in which it is voluminous. It will appear from what precedes, that we consider the four-branched forceps better adapted, than any other, to overcome the difficulty of seizing the stone, without pinching the bladder.

With respect to the shell-breaker, it may be well to repeat here, that it is the only Lithotritic instrument we possess which is well adapted to the treatment of large flat calculi. Great praise is unquestionably due to Baron Heurteloup for its invention; but he is entitled to much more for having furnished us, more perfectly than any other person, with one of the two important conditions necessary for curing stone in the bladder without cutting, namely, that of seizing and retaining a calculus with safety to the organ containing it. Were he to furnish us with

the other condition, that of destroying it when seized with like security, his merits as a Lithotritist would be unequalled.

The annexed table will exhibit, at one view, the Lithotritic means and instruments now employed, with reference to their application to the principal varieties of stone.

Instruments.	*Means.*	*To be preferred in cases of*
Three-branched forceps and drill.	Attrition and Pressure.	Small, round calculi consisting chiefly of uric acid or the phosphates.
Ditto.	Successive perforations and pressure.	Large, round calculi of similar composition.
Four-branched forceps with excavator, or concentric saw.	Excavation and Percussion; or concentric pulverization.	Large, spherical calculi chiefly composed of the oxalate of lime.
Shell-breaker.	Attrition and pressure.	Large flat calculi.
Percussor-Sound.	Percussion.	Soft flat calculi.

In general, several applications of the instruments are necessary to effect a cure;

the duration of each, as well as the time allowed to intervene between them, must vary according to the volume, form and chemical composition of the stone, the state of the bladder, and the strength and constitution of the patient. Upon an average, five or six applications are sufficient; but the Surgeon should never forget, that it is much better to destroy the stone little by little, than to fatigue the patient by continuing the operation too long at one time. As to the time allowed to elapse between each application of the instrument, it will vary from one or two days to several weeks; it must depend on the state of the patient: whilst there is much irritation in the bladder the operation cannot be continued with safety. When there are many fragments, all the skill and patience of the operator will be required, as well to pulverize or extract them, as to guard against the accidents which not unfrequently they occasion. The most elaborate dissertation upon the different steps of the operation would ill suffice to

qualify a Surgeon to perform it. He can acquire the practical tact which it demands, only by repeating it frequently on the dead subject. He will then become acquainted with many little difficulties which attend it, and learn to overcome them. It should never be undertaken by any but a well educated Surgeon, and without practice he cannot succeed, because he will feel no confidence where so much depends upon tactile phenomena. The great difficulty is, unquestionably, to lay hold of the stone without injuring the bladder: it is to be vanquished by practice, and by the perfectness of the instrument, which should be so constructed that its branches expand without bruising the neck of the bladder.

There is another thing which it is of great importance to notice: he ought, for reasons to be assigned hereafter, always to be ready to perform Lithotomy, if required, at a moment's warning, and should never be without the necessary instruments.

Case 8.

Robert Platford (of Norwich) ætat, 80, of a strong constitution and remarkably active for his age, submitted to the operation of Lithotomy in his sixty ninth year, (1818) when a stone weighing ℥1. ℈j. slightly nodulated, and composed chiefly of lithic acid, was extracted by my skilful friend Mr. Crosse, who, on that occasion, used the cutting gorget. The calculus was an inch and a half long, about one inch in breadth, and somewhat flattened: it had produced the usual effects on the patient for three years; and, three weeks prior to the operation, became intolerably painful, obliging him to void his urine every quarter of an hour, and producing hematuria and general derangement of his health. A pint of blood was lost during the operation, which, although simple, and completed in three minutes, was followed by very serious symptoms. At the end of a month, however, the wound was nearly

healed, and, at the end of eleven weeks, the patient was able to resume his occupations as a weaver.

About the middle of 1829, the patient was again attacked with pain and dysuria; the urine was expelled at short intervals, and frequently mixed with blood. He again applied to Mr. Crosse, who, considering his great age, the apparently small size of the stone, and the capacity of the urethra, which readily admitted a large sound, resolved on the application of Lithotrity, and did me the honour to entrust me with the operation. We sounded the patient several times, and decided that the calculus, was, in all probability, not more than an inch in diameter.

September 6th. The patient was kept quiet and gently purged, emollient drinks were also prescribed.

September 7th. We proceeded to the operation in the presence of Sir Charles

Clarke, who kindly honoured us with his valuable assistance, Mr. Millard, and several of Mr. Crosse's pupils. The patient, who had retained his urine for several hours, was placed lengthwise on the side of the bed, his pelvis raised upon pillows. I passed the three-branched instrument into the bladder without difficulty, and after searching for several minutes succeeded in placing its end against the stone. Turning it so as to have one of the branches upwards, I opened it, by drawing back the external canula about an inch and a quarter, and endeavoured to pass the lower branches over the calculus. In this I did not succeed, and, as the bladder contracted with great force, it became necessary to close the instrument. After a few minutes I opened it again, and succeeded by the same method, in fairly grasping the stone, which the scale indicated to be about three quarters of an inch in diameter; having fixed the external tubes I applied the borer to the calculus, and by a little rotation and pressure, crushed it to pieces in a few se-

conds. The instrument was then closed, and withdrawn from the bladder without difficulty; the intervals between its branches were filled with small fragments. The patient immediately rose up and expressed himself much gratified at the result. (*Tinct. opii. gr. xxx. Mucelaginous, warm drinks. Hot poultices to the hypogastrum.*

September 8th. The patient had passed a comfortable night, and was free from pain; pulse soft, skin moist. He observed it had been very different the day after he underwent Lithotomy: the urine was turbid and bloody, and contained half a teaspoonful of fragments.

September 9th. Slight pain in the abdominal extremities; the patient complains of stiffness. (*Ol. Ricin.* ʒvi.) Nearly as many fragments were contained in the urine, which began to assume its natural appearance.

September 10th. The patient seemed

quite well: the urine was scarcely tinged with blood, but contained several small fragments.

September 11th. Mr. Crosse sounded him carefully, and declared the bladder to be free from any foreign body, save the remains of the gravel, which came away entirely, in about three days.

The above, which is one of the first instances of the successful application of Lithotrity in this country, affords a convincing proof that the operation can be performed almost without preparation, where the bladder is large, healthy, and of rather obtuse sensibility. Had the preparatory treatment been more complete, the violent contraction excited at one period of the process, by the presence of the instruments, would probably have been prevented; and, we note this feature of the case as indicative of an error to be avoided, rather than as an example deserving imitation. In the following case

the history and treatment of which belong to my dexterous friend, Mr. Costello, who confided the preparation of the patient to me, great pains were taken to induce, prior to the operation, that state of quietude so favourable to its success. I have singled it out, partly on this account, and partly, because, compared with the preceding one, it presents some other points of contrast well worthy of attention. By nature, the first patient was a most favourable, the other a most unfavourable subject for the operation; in one case, the stone was soft and small, in the other hard and more voluminous; in the first case, one application of the instrument was sufficient; in the other, it was necessary to apply it, at five successive intervals. It is also worthy of remark, that both these patients had once submitted to Lithotomy which threatened to be fatal; whereas, Lithotrity seemed to put their life in less jeopardy than some of the paroxysms of pain produced by the disease alone.

Case 9.

Mr. Thomas Heath, a farmer, residing at Kirkby, near Mansfield, Notts, aged 57, very corpulent in habit, experienced the first symptoms of stone in the bladder, eight years ago. Being a single man, he bore his sufferings in silence for two years, and took no advice. At this period, he made a short journey on horseback to pay his rent, and having, contrary to his habits, partaken of the punch prepared for the tenants, he became much alarmed at finding that he was unable to pass a drop of urine. This retention lasted five hours, and his return home was attended with acute suffering; he was confined to bed for a week, and frequently voided blood with his urine; at the end of this time, he passed a small, lentil-shaped stone, about the size of a pea. Its expulsion was followed by immediate relief. His freedom from pain, however, was of short duration; his symptoms returned, and he continued to suffer

severely, for the next six months; but, still the urine was nearly natural, and he was able to move about; he became worse, and, during the two years which preceded the first operation, his life was a long torment. The urine became turbid and bloody, and, in severe crises, it deposited a quantity of slimy mucus which adhered to the pot. Life being a burden, he made up his mind to undergo the operation. For this purpose he repaired to Nottingham. The operation was performed on the 7th November, 1827, by Mr. Attenburrow, a distinguished Surgeon and Lithotomist of that town. Owing to the depth of the perinæum, and the size of the stone, the operation was long and laborious, and there was considerable hemorrhage. Seven weeks from the time of its performance, he was able to return home; but his convalescence was slow, and the wound was not completely cicatrised till the end of March; his respite from suffering, however, was of short duration. In April, he felt the renewed attacks of his disease, and, in June, all his

old symptoms had re-appeared. He had submitted to the operation in the hope of permanent relief. He saw, with despair, that he had obtained but a short truce, and that he was once more a prey to the protracted martyrdom of stone. The operation was again spoken of, but nothing could overcome his repugnance to submit to it. In the month of November he passed another small rough calculus, but experienced no diminution of suffering. During the two following years, his torments were indescribable. Through Mr. Nathan Cooper, of Mansfield, his Surgeon, he learned that there was a milder method of cure for his disease, and at the recommendation of Mr. Grainger, who spoke favourably of Lithotrity, and the Hon. and Rev. Mr. Vernon, rector of his parish, he came to town. When I first saw him his condition was truly deplorable. The slightest motion was productive of intense pain; his breathing was short, even to panting; his sleep was broken, the irritability of the bladder being so excessive as to force him

to make water, every ten or fifteen minutes, throughout the entire night; his mind was so broken, that he shed tears on the slightest emotion; the urine was ropy and fetid. With such a formidable train of symptoms I had doubt of the applicability of Lithotrity. Opiates were ordered, and a soothing treatment was adopted.* This was attended with such good effect, that at the end of a few weeks, the number of calls to make water was reduced to twelve times in a night. When the irritability was thus diminished, the operation was begun. The first sitting took place three weeks ago. An injection of four ounces of water was thrown into the bladder, a large Lithotrite was used, and the stone measuring an inch in both its diameters was seized. Three perforations were made in it, before it was suffered to escape from

* During this treatment, which lasted several weeks, I took a full bleeding from the arm, and injected the bladder twice or thrice a week, with tepid mucelaginous water containing two drachms of the Tinctura Opii. *(T. K.)*

the grasp of the instrument. It was seized again and reduced to large fragments, by the pressure of the branches and drill. This sitting lasted ten minutes. The night following the operation, he made water only seven times; there was nothing remarkable in the introduction of the Lithotrite, except that it produced pain in passing over the old cicatrix of the urethra. At the second sitting, the water escaped between the urethra and Lithotrite: only one fragment was seized and crushed; the operation lasted one minute. At the third, the bladder was tranquil; and fragments were seized and broken seven times. At the fourth, very few were found, and at the fifth, only one, which was extracted in the instrument. The two last sittings took place at my own house, and it is now but three weeks, since the operation was commenced, which has raised up Mr. Heath from a bed of torture. (*Report of the proceedings at the Westminster Medical Society, from the Lancet of April*, 16, 1831.)

The great character by which Lithotrity is distinguished from, and elevated above Lithotomy, is, that it accords far better with the recurrent nature of calculous disorders. When once the kidneys have taken upon themselves to secrete gravel, it is difficult to put a lasting stop to the habit. Whatever means are adopted, there always remains a certain predisposition to resume an action that has before existed, and the slightest causes may occasion a relapse. If, then, the disease is liable to return, and to return frequently, it requires a remedy that can be repeated without the risk of life: such is not Lithotomy; but approaching to such, appears to be Lithotrity. When a patient is cut for stone, the operation puts life in danger, yet, it is no protection against a return of the disease; and, as often as it is repeated, so often does the patient risk his life. Lithotrity, on the contrary, does not endanger life: it can be repeated with safety, and applied with effect, at the first moment of a relapse; it has also the great advantage, that

the patient can contemplate it without the dread which Lithotomy creates, not only in him, but even in the operator himself.

. . . . . .

It was a happy thought, that of reducing a stone in the bladder to a state which admits of its passing away with the urine. While in the form of gravel, urinary concretions are expelled by a natural process, in fact, by the exercise of the organs in which they are lodged; nature has this resource, until they become too voluminous to escape through the urethra; what, then, can be more rational than to restore to her this power, in making them re-assume the form of gravel, by acting upon the morbid product, rather than by maiming a healthy organ? We do not pretend, that, in the present state of Lithotrity, the morbid production can be got rid of without great pain, and some injury to the organ containing it; but, this is owing to the deficiency of our instruments, and not to any defect in the plan. Few operations, indeed, are so well founded as Lithotrity;

and, when once we possess instruments a little more perfect than those now in use, stone in the bladder will not be deemed a more serious disease than gravel.

The only mode that could possibly be thought of, for accommodating nature at less expence, would be to cause the stone to return to a liquid state; but, since there is scarcely a hope of our ever dissolving it in the bladder, our great aim should be to perfect the instruments for its pulverization, and to discover sure means for preventing its re-production.

We have now to take into consideration the principal objections which have been made to Lithotrity.

1. A great deal has been said about the difficulty of seizing the stone; many considering it so great as to prevent the general adoption of the operation. The ablest Surgeons, say they, have been foiled in their attempts to lay hold of the calculus,

and those who style themselves Lithotritists, nearly as often. But, the answer to this is, that the difficulty, however great, (and certainly it is the greatest attending the operation) is to be overcome by patience and that dexterity which practice gives. Besides, it has been, in a great measure, obviated by Baron Heurteloup. With his bed, the stone can almost always be made to roll to the back part of the floor of the bladder, where a Surgeon who has practised on the dead subject, will seldom fail to grasp it.

2. The liability to contuse and pinch the bladder is certainly a serious objection; and, it cannot be denied that these injuries are sometimes inflicted. But, although the coats of the bladder may, by chance, be caught in the forceps by an expert operator, he will discover the accident early enough to avoid doing them any fatal or serious violence. We are inclined to believe, that except on very rare occasions, he must be rather inexpert who

could pinch or strike the bladder so severely as to produce contusion, laceration, or violent inflammation.

3. Another strong objection, founded upon the occurrence of the accident to some of the best Lithotritists, is, that the instruments are liable to break in the bladder. Now, admitting this may have happened once in twenty or thirty operations, when we consider that it is to be attributed to defects in the instruments, which are rendered every day more perfect and less fragile, is it too much to expect, that the time will come when such an occurrence shall be unheard of? When it does take place, the patient must generally undergo Lithotomy; but, even then, he is not in a worse condition than he would have been before the invention of Lithotrity. He may possibly be in less favourable circumstances, from the irritation already produced by the Lithotritic process; in most cases, however, he will not. In a very unirritable patient, the detached piece of instru-

ment might, perhaps, be attracted and drawn through the urethra with a magnetized rod, it might even find its way out spontaneously; but, since in most cases of this kind, Lithotomy must be performed without delay, the Surgeon should always have the requisite instruments at hand, as well as a magnet.

4. It has been stated, that, if the branches of the forceps cross each other, or become entangled in a hole of the stone, there is no possibility of withdrawing the instrument, without lacerating the urethra. This would certainly be a very embarrassing accident, and, although there is no evidence that it ever occurred, its bare possibility should induce the Surgeon to provide against it. If unable to put things right with a steel rod, he would be obliged to have recourse to an opening in the bladder, by the perinæum, through which he might disentangle the end of the instrument with his finger, or in case of this failing, cut it off with a pair of

curved nippers I have had constructed for the purpose, and with which he should always be furnished. But, the best provision against such an accident, would be to have the branches of the forceps separate throughout, as recommended by Messrs. Costello and Guthrie, so that, by withdrawing the external tube, they might be removed one at a time.

5. Several eminent practitioners contend that the principle of reducing a stone in the bladder to fragments, is bad and untenable; they are of opinion, that the presence of these fragments, in so delicate an organ, is sufficient to produce dangerous inflammation; that the frequent application of the instrument required to destroy them, very often occasions the same result, and finally, that, in spite of the greatest skill and attention, one may remain unpulverized, and become the nucleus of a new calculus.

With respect to inflammation occurring

from the presence of fragments in the bladder, it would seem, *à priori*, that when rough and uneven, they must irritate the organ more than the entire calculus with its smoother surface. Yet, strange as it may appear, the latter is mostly attended with severer symptoms. This, perhaps, may be partly explained by the satisfaction which the patient experiences on hearing the calculus broken to pieces, and partly by the escape of several fragments, which necessarily diminishes the weight upon the floor of the bladder. The effect produced on the patient, when he knows the stone has given way—that his enemy is crushed—is certainly very striking. But, I have had occasion to remark, that the pain produced by a stone is not always in the ratio of its roughness. I remember finding a mulberry calculus, as big as a hen's egg, in the bladder of a man who was suddenly killed by a fall from the top of a house, in Paris; the organ was perfectly sound, and exhibited one of the best and most beautiful samples of a healthy

mucous membrane I ever beheld. We are far from asserting that fragments do not sometimes occasion serious inflammation: but, we maintain, that in the great majority of cases they do not, and where they have this effect, a good Surgeon will be almost certain to succeed in counteracting it. On the same ground, they object to an operation requiring several applications of the instruments. No doubt, the necessity there is for this repetition, is to be regretted—but, why is it to be regretted? not, because it makes Lithotrity any thing like so dangerous as Lithotomy, but, because it makes it long and painful. In many respects, it is deeply to be regretted, that we cannot always destroy a stone at one sitting; but, after all, the object is not so much to cure the disease, in the quickest possible time, or with the least possible pain, as to cure it without risk of life; and, if this can be done by additional pain, who would not think it his duty to submit to it?

The whole problem is, I know, to cure the disease in the bladder with the least possible pain and danger, in the quickest possible time. But, since we cannot obtain equally these results, and must choose between time, pain and safety on the one hand, and danger and promptness on the other, it is our duty to prefer security: time ought in all cases to be sacrificed to safety; safety to time, never. My wish is to apply this remark to all plans for curing stone; and, I have no hesitation in saying, that had I to choose between an instrument which would remove from a stone three grains daily, with perfect safety, and one that would destroy it in ten minutes with some danger, I should prefer the former. Time is not to be grudged, when it is to purchase with certainty and safety, freedom from one of the most agonizing diseases. If we can once arrive at the means of destroying a stone at intervals, and by degrees, without danger or inconvenience, it matters little how often they are employed, or how trivial the effect of

each application of them. Every grain removed is so much relief to the patient, who not only ceases to dread the operation, but actually hastens its repetition: he is in the state of mind of one, who engaged in an arduous undertaking, derives, from the satisfaction experienced at every successful step, fresh encouragement to proceed.

It should not be forgotten, that a cure is not very promptly obtained by Lithotomy; after cutting, the patient remains in a very critical state till the wound is healed, and a long convalescence is always the result of this severe operation.

With regard to a relapse of the disease we admit, that it may be more frequent after Lithotrity, than after Lithotomy; the nature of the disease, however, is such, that the latter operation is no protection against it. Indeed, there is but little trouble taken, after cutting, to clear the bladder of any fragments which may have

been broken off with the forceps; the Surgeon is anxious to get his patient to bed as soon as possible, knowing that the operation itself is quite enough for life to struggle with. On this account, perhaps, the formation of a new stone is very nearly as common as after Lithotrity. Relapse after any surgical operation is not only dreadful to the patient, but extremely mortifying to the Surgeon, whom it disheartens, by impressing him with, perhaps, an inordinate conviction of the want of permanent efficacy in our remedial resources; but, if there be a cure where relapse is less unfortunate than in others, it is surely that in which the remedy is always at hand, and can always be applied without risk of life. It is impossible to repeat too often, that the grand and characteristic advantage of Lithotrity is its appropriation to the nature of calculous affections, from which no period of life is exempt, and which, depending in a very great degree upon idiosyncrasy, may be liable to recur every three months. I well remember the case

of a youth who was cut for stone, at the Hotel Dieu, in whose bladder upwards of two hundred small calculi were found. He died from the severity of the operation. Now, his life would have been saved with ease, had Lithotrity (then unknown) been applied as each calculus descended into the bladder from the kidneys. I verily believe, that, excepting children, a very large portion of those operated upon by Lithotomy, have been afflicted with a relapse. Several of such cases have come under my own immediate observation; and, on one patient, I saw the operation performed for the third time. Before the invention of Lithotrity, no one at all acquainted with the subject—not even the most courageous man that ever existed—could contemplate the recurrence of this terrific disease, without the most awful apprehensions; but, now, I see patients calm, and hear them exclaim, in reference to fresh symptoms, "Oh! it will only be a little more grinding."

The opponents of Lithotrity have not failed to enumerate, at full length, the cases to which it is inapplicable: those where the stone is very hard, or very voluminous, or encysted; diseases of the prostate; urethræ originally very small, or contracted from strictures, have been much dwelt upon. In considering these dispassionately, it will be found, that they do not constitute any thing like a foundation for hostility to the general adoption of the operation. In some adults, where the urethra is naturally very narrow, it may sometimes be impossible to introduce the smallest instrument; but, this is very rare indeed. And, in children, Lithotomy, well performed, loses three-fourths of its dangers, differing by its lenity, nearly as much as Lithotrity does, from the same operation performed on grown persons.

Strictures seldom exist, in such a form, and to such an extent, as to prevent the adoption of the operation; for, unless the symptoms of stone are extremely urgent,

time may be taken to dilate the urethra. Persons affected with stricture have generally their attention drawn to the state of the urinary organs; therefore, they are not so likely as others, to delay applying for relief, until the stone has become voluminous, and the symptoms are of immediate urgency.

The prostate, either from an increase of size or some peculiarity of form, is sometimes an obstacle to the use of Lithotritic instruments; but, such a disposition is not often observed, perhaps, not in more than one of a hundred cases, and, by scrupulous attention to a methodical plan of preparatory treatment, the proportion of those, in which it is an insurmountable obstacle, will be still less.

To those cases where the stone is encysted, I do not see how Lithotomy should be more applicable than Lithotrity; it seems to me, on the contrary, that it is less so; for, there is a greater chance of

dislodging the calculus by an exploration of the bladder, that may be made in any position, continued for almost any length of time, and frequently repeated, than by probing through a deep wound, whose severity necessarily obliges the Surgeon to limit, to a very short time, researches which cannot be repeated. Indeed, no one would be justified in cutting in such a case, were he certain of the nature of it, (for it would be at the risk of not finding the stone,) unless the symptoms were violent; and, happily, in such cases they are often so much the reverse, as not to require any operation at all.

There are, doubtless, some cases where the stone is too large to be grasped with the Lithotritic forceps, and others, where it is so hard as to resist the action of any instrument that can be passed down the urethra. But, the number of the former will diminish every year, as the easy means we now possess for destroying a small calculus, come to be generally employed.

The operation of Lithotomy was considered so serious, and even the name of it was so frightful to patients, that cradling themselves in the hope that their disease might be some other than stone, they did not dare to apply for medical advice, which might convert their worst fears into the much dreaded reality, until the severity of the symptoms made life almost insupportable. Were the calculus large or small, there was no other alternative than submitting to a wound in the bladder. It is on this account, that Surgeons have so frequently had the misfortune to find a large stone. But, now, patients will be anxious to ascertain, at the first moment they experience any thing like symptoms of the disease, whether it exist or not, knowing that the sooner its presence is revealed, the more prompt and less inconvenient the cure; and, that when attacked at the onset, it is to be vanquished without requiring other sacrifice of them, than submission to pain, which, although severe, is of but short duration.

In the winter of last year, I was called to visit Mr. L., who lay on his death bed, in the last stage of this cruel disease. I had frequently met this gentleman, at a friend's house; and, although, in conversation he would, at times, touch upon his sufferings, the moment I put any question, which he saw was directed to discover the nature of his complaint, he would contrive to change the topic, or change his place; such was his dread of a disease, rendered terrific by what he had heard of Lithotomy. He was prevailed upon to send for me, when it was too late: I could only allay pain; ulceration, which had taken place, to a great extent, in the intestines, terminated his career a few days afterwards.

Calculi of excessive hardness may be said to belong to the same class, for, unless large, they may be treated successfully by Lithotrity. To the few cases, in which this operation is inapplicable, those of children excepted, we have some sugges-

tions to make, which may, perhaps, induce practitioners to adopt a plan hereafter to be described, devoid, it is true, of many of the advantages of Lithotrity, of which it is a modification, but of a nature less fatal than Lithotomy.

After this enquiry into the principal circumstances connected with the treatment of stone, by Lithotomy and Lithotrity—in which we have attempted to place side by side, their respective dangers and advantages, by an appeal to facts, and thus to establish the degree of estimation in which each ought to be holden in practice, —our conviction is, that wherever Lithotrity can be employed, Lithotomy should never be thought of.

Whether we look at the structure of the parts concerned, at the nature of the disease, or at the results furnished by experience, we are led to the same conclusion. Every thing conspires to establish the superiority of Lithotrity, and to place

it at an almost immeasurable distance above Lithotomy. A wound in the bladder, of itself, endangers life, more or less, even when uncomplicated by the serious accidents we have had occasion to notice, and every one of which may separately cause death. On the other hand, the objections that can be made to Lithotrity, however numerous, are but as dust in the balance, when weighed with those which belong to the other plan; and, were we to attempt to express, in a few words, the verdict imperatively called for, by the testimony of reason and experience, that verdict would be—the abolition of Lithotomy.

PROPOSALS

FOR THE

TREATMENT OF CALCULI

OF

GREAT MAGNITUDE AND DENSITY.

The suggestions I have to make respecting the treatment of those cases, in which, from the volume and hardness of the stone, the extreme irritability of the patient, or any other circumstance, Lithotrity cannot be employed, will be comprised in a few words.

Hitherto, it has been an axiom in performing Lithotomy, to suit the opening made into the bladder to the volume of the stone; and this was done partly with the knife, partly by dilating the wound, and partly by laceration. I mean, that

when an operator found the branches of his forceps widely apart, grasping a calculus too large to pass through the incision by gentle pressure, he was compelled, either to use greater efforts and run the risk of causing contusion and laceration, or to enlarge the opening; and, less fatal was it for the patient, if he preferred the latter.

The principle of Lithotomy—Lithotomy of the safest and best kind—is, then, to have the *incision* proportionate to the *size of the stone.* Now, what I would suggest is, that this principle be reversed, and that the *stone* be reduced to the limits of a tolerably safe incision. In Lithotomy, the rule is, to adapt the *wound* to the *calculus;* whereas, I propose, adapting the *calculus* to the *wound.* This new plan may be called perinæal Lithotrity.

It consists in a small incision made into the membranous portion of the urethra and anterior part of the prostate, and in

the reduction of the stone, to such fragments as may be immediately extracted through it. The almost constantly successful issue of those operations, in which the calculus happened to break in the forceps, had made a strong impression on my mind, long before the invention of Lithotrity; and, for several years, I have entertained the opinion, that it would always be far better to break the foreign body, than to risk lacerating the prostate and bladder. But, the evil of leaving fragments in the bladder appeared to me to be so great, that I deferred recommending the plan, until I saw the possibility of obviating this objection—an objection, which has probably deterred from doing it more experienced Surgeons than myself. For, since my determination to make it public, I have understood that something similar was once suggested to the Académie de Chirurgie, by the celebrated Dubois; to whom, I am told, the merit of first starting the idea evidently belongs, and in whom I am quite willing

to acknowledge it; although, I feel bound to state that I have borrowed it from no one, and that it is the result of my own reflection. At the same time, I admit, that it has been to me a source of satisfaction and encouragement, to have, in some measure, the sanction of one of the best Surgeons of the age, in an endeavour to substitute for the desperate operation of Lithotomy, a more safe and judicious process. Besides, the propriety of breaking very large stones has been long advocated, as will appear from the following passage, which I extract from the excellent treatise on Surgery, by Benjamin Bell, who has given the delineation of a forceps used for the purpose. He says:—
"But, although a few instances have occurred of patients recovering, from whom stones have been extracted of a large size, yet, whenever the stone exceeds seven or eight ounces in weight, so far as I am able to judge, not above one in ten recovers. This, therefore, is a most material circumstance, and worthy of our most serious

attention; and, although the breaking of a stone in the course of extraction, is in other respects rather disagreeable, yet with a view to obviate the dreadful consequences which commonly ensue from tearing out a very large stone, when, in the course of an operation, it is found that the stone is of an uncommon magnitude, and that it cannot be extracted but with great hazard to the patient, might it not be more eligible, either to endeavour to break the stone with the forceps already introduced, or to withdraw these and to introduce an instrument represented in Plate xvii., fig. 1., originally invented for this purpose, by Andreas à Cruce, and since improved by Lecat and others? By means of the long and strong teeth, with which these forceps are furnished, and especially by the intervention of the screw for compressing their handles, almost any stone may be broke into very small pieces; and, as soon as this is effected, the different pieces may be extracted by the common forceps.

"In such circumstances, however, or when a stone has broke by accident in the course of any operation, the utmost care is necessary in order to extract every fragment of it; for, if the smallest particle be left, if it be not afterwards washed away with the urine, it may prove very prejudicial, by serving as a nucleus for the formation of another stone."

In order to meet the objection founded upon the inconvenience of scattering the bladder with fragments, I have endeavoured to devise means for enclosing the calculus in a bag, prior to breaking it to pieces. The instrument I use for the purpose is a light forceps, having the upper blade split into two branches, which are made to open and shut, and to which the end of a bag is adjusted for receiving the calculus. When the latter is pressed in the forceps, at the same time, that the branches of the upper blade are gradually expanded, it necessarily passes between them into the orifice of the bag, in which,

by continuing the pressure it becomes finally enveloped.

The next object was to find the best means of breaking the stone, in the quickest possible time. I tried several instruments, some constructed on the model of the forceps of Andreas à Cruce, with long strong branches, and wedge-shaped teeth in the blades; others having a contrivance for breaking the stone with a wedge or percussor; and one like that used by Baron Heurteloup for breaking calculi by percussion. Those of the first kind are the most simple, and give the least trouble in seizing the stone, and as they are extremely powerful, few calculi will resist their action. With the others, the hardest calculi may be broken, but they do not offer the same facility for grasping them.

The operation is performed in the following manner. The patient, who should be prepared as before submitting to Litho-

tomy, is to be placed upon Baron Heurteloup's bed. I introduce into the bladder a slightly curved staff, which is held by an assistant, nearly on the median line, whilst I make an incision up to it through the perinæum. This incision, about an inch and a half long and extending from a central point about an inch and a half below the inferior part of the symphysis pubis towards the left side of the anus, is made in two or three strokes with a straight, pointed knife; one serving to open the urethra from the left side of the bulb backwards, as in Lithotomy. I use Blizard's knife, or a sheathed instrument, to extend the opening to the anterior part of the prostate. A small conductor is then passed through the opening into the bladder, in the groove of the staff; and, the latter being withdrawn, I exchange the conductor for the forceps. Thus far, the operation differs from Lithotomy, only, in as much as the incision is made just sufficiently extensive to admit the forceps. In introducing the latter, the principal part

of the bag, previously oiled, is kept close to the double or upper blade, which, when the stone is grasped, is to be gradually opened. As soon as the calculus is completely enclosed, the branches are to be shut and brought near the wound, in order that the end of the bag may be made secure and detached from them. The forceps is then to be withdrawn. It is through that part of the bag hanging out of the wound, that the instrument for breaking the stone is to be introduced, guided by the finger or a conductor; and, as the patient is placed in the position required for seizing the foreign body in Lithotrity, the stone, which cannot escape from the bag, will be easily grasped.

If the forceps of Andreas à Cruce be used for this purpose, the plan is, to hold it firmly in the left hand, and with the right to crush the calculus between its branches, either by direct pressure, or with the screw. When the stone is very hard, the wedge or percussor may be necessary to break it;

but, in this case, whatever instrument we use must be fixed well in the vice of the bed, before we proceed to crush the calculus. As soon as this is effected, the instrument closed upon a certain portion of fragments is to be withdrawn, and a scoop forceps substituted, to bring away a sufficient quantity of them for allowing the bag to be extracted with the remainder. Should any of them escape through a hole made accidentally in the bag, they must be washed out of the bladder with warm injections. The chief objection to this plan arises from the difficulty of enclosing the stone in a bag not liable to be torn so as to let out the fragments; and, I confess I have not yet discovered the means of entirely obviating it, although I have made it a sort of study. As, however, I have been able to improve the instruments I first used, others may be induced to turn their attention to the subject, till, at last, we obtain perfect machinery. For instance, at first I made a bag of oiled-silk, fourteen inches long, entire at one end to

the distance of seven inches, and in the rest of its extent, split into an upper and an under portion. Where these portions join the entire part of the bag, there is a contrivance for opening it, whilst the Surgeon, holding a slip in each hand, draws it over the stone like a night cap. I had a notion that when the stone was seized, one of these portions might be passed over it, by means of an elastic slide, contained in a curved flat canula; but, this mode of enveloping the stone is far inferior to the other.

From the consequences we have already noticed, the presence of fragments in the bladder must be viewed as a serious evil; but then, it should be recollected, that in Lithotomy, when the stone is large, fragments are often chipped off; and, in this event, are they not quite as likely to remain in the bladder; since the Surgeon, anxious to get his patient to bed, after an operation of which the shock is so great as to leave little strength for delay, dares not

give up any time to the precautions necessary for clearing the bladder completely? And, admitting that the chance of a relapse is greater than after Lithotomy, can the inconvenience of this occurrence, which would subject the patient to undergo Lithotrity at a future period, be compared to the consequences which so frequently follow an extensive incision or the forcible extraction of the stone?

The length of time required for the performance of the operation, and the necessary pain and irritation attending it, constitute another objection to perinæal Lithotrity. But, again, we ask, whether they endanger the life of the patient? What does reasoning upon analogy, what does experience teach us on this point? In Lithotomy, it is not the frequent introduction of instruments, or the time employed, that renders the operation dangerous, but the extent of the incision or the force employed to extract the stone; and, when hemorrhage is avoided, when we

are secure from infiltration of urine, when the bladder has not been forced or the prostate lacerated, we may expect a successful result.

The bladder, as we have often repeated, is not only an important but a highly sensible organ, and nothing solid can come in contact with its membranes without producing pain; therefore no operation performed on it can be exempt from pain. This will be more protracted in perinæal Lithotrity, than in Lithotomy, but it will certainly be less acute; it will not produce those cries so frequently heard during the extraction of a large stone, and which indicate a shock upon the nervous system carrying annihilation with it. The patient will be spared that severe injury to which nature so often succumbs, and if he have to suffer longer, he will certainly suffer less.

It is hoped that practitioners, in considering this new operation, will bear in mind that it is proposed only for those

rare cases in which Lithotrity is inapplicable, and where the stone exceeds an inch and a half in two of its diameters. As yet, I have not met with a case requiring it, and therefore cannot support it by an appeal to any successful result upon the living subject; but, I would again call attention to the fact, that, almost always where Lithotomy has been successfully performed for a large stone, the latter has crumbled in the forceps during the attempt to extract it. The operators may not have acknowledged that they crushed the calculi intentionally, but, few will deny, that the occurrence of what the inexperienced in such cases have termed a disagreeable accident, was to them a source of relief to the most intense anxiety. When a Surgeon finds, either unexpectedly or not, a large stone, he is almost sure to squeeze it with all his might; feeling, as it were, instinctively, that something must give way; and, I have often wondered he never claims the merit of causing an effect, which

to the patient makes all the difference between life and death.

From time to time, though fortunately at long intervals, we hear of cases, where the operator, after having actually performed the cutting part of Lithotomy,—after having opened the bladder beneath the pubes or above the pubes, or in both directions—is unable, from the immense size and extreme hardness of the stone, either to extract or to break it. The patient, with all the energy which the anguish of such a crisis may be well imagined to create, calls in vain for the completion of the operation; for he must often be sent to bed with both the stone and a large wound in his bladder.

But, the Surgeon is also much to be pitied; he has no rule to guide him, and, although, by reiterated efforts, and after a trial generally fatal to the sufferer, he may sometimes succeed in breaking the stone with a strong forceps, he is often

less fortunate and obliged to consign the patient to what, he knows, must be his death-bed.

When the calculus fills the bladder, frequently it cannot be extracted at all, even by the high operation, and never without great difficulty and risk of life. He who has not encountered such a case, can form no conception of the embarrassment attending it, and no one who has witnessed the difficulty can help shuddering at the recollection of it.

The following, extracted from the Lancet, of May, 8, 1830, is a recent instance of the kind to which I allude :—

D. ætat. 33, had, almost from his infancy, been suffering from the effects of stone, the presence of which in the bladder, had been ascertained as early as his eighth year. He had never undergone any surgical or medical treatment for it, although he had almost continually been affected

with the symptoms attending such a state. It appeared, however, that his general health had not suffered much, and he was even, still, of a vigorous constitution; but, latterly, the pain in the lumbar region had increased to such a degree as to induce him to enter the Hospital, under the care of Mr. Civiale. He was then without fever, but complained of violent pain and much difficulty in making water; and, on examination with the sound, and the finger in the rectum, a very large stone was discovered. Lithotrity appeared, in this case, to be impracticable, as well as any other method, except the high operation of Lithotomy, which was performed on the third of April, in the following manner. A silver catheter being introduced into the urethra, was found to pass between the stone and the anterior paries of the bladder. An injection of water was now made, which caused such violent pain as to oblige the operator to defer the operation, until the irritability of the bladder had somewhat subsided. The catheter was then re-

placed by the "Sonde à dard," and Mr. C. having made a longitudinal incision through the abdominal muscles, of about four inches in length, divided* the peritonæum with a probe-pointed bistoury. The "sonde à dard" was now carried upwards and the bladder divided by a bistoury sliding along its groove; at the same time the operator introduced his fore finger into the bladder, and was thus able to make the aperture as large as he thought would be sufficient for the extraction of the stone. A blunt hook was carried into the upper angle of the wound, and a pair of forceps into the bladder, to grasp the stone, which, however, was found so extremely large and at the same time so immoveable, as to shew at once the impossibility of extracting it entire; Mr. C. accordingly endeavoured to break it to pieces, and in this attempt he ultimately succeeded. From the shape of some of the superficial frag-

* I suppose it should be *detached* instead of *divided*: surely Mr. C. did not cut through the peritonæum. *(T. K.)*

ments, it appeared, that the size of the stone was about that of an infant's head; the number of fragments was very great, and Mr. C. was occupied for more than a quarter of an hour in removing them; altogether they amounted to a pound in weight. During this part of the operation it was observed, that the diaphragm and abdominal muscles repeatedly contracted, and almost immoveably fixed the forceps in the bladder. The operation which lasted three quarters of an hour, and during which, a considerable quantity of blood was lost, was borne with extraordinary courage. The wound was simply dressed and the patient removed into bed, apparently in a state of extreme exhaustion; he died five hours after the operation.

On examination, the kidneys were found considerally enlarged, of a very dark red colour; their cortical substance was softened, and in some places changed into a greyish pulp; the internal substance was less disorganised; the infundibula pelvis

and ureters were very large, thickened and much injected. The parietes of the bladder were greatly thickened; its mucous membrane was of a dark brown colour, softened, almost fungous, and covered with a considerable quantity of very firm cartilaginous laminæ of a grey colour; its cavity contained a considerable quantity of coagulated blood. (Lancette Françoise.)

We see here, that the operator, finding the stone immoveable, and so voluminous that there was no possibility of extracting it entire, *endeavoured* to break it to pieces; and that he *ultimately* succeeded. What those endeavours were, and how he ultimately succeeded, we are left to divine.

Now, it would not in the slightest degree impugn his professional skill, to suppose, that, after making several attempts to extract the stone, and finding he could not move it, he had recourse to whatever means were at hand to break it; and, that these, suggested at a moment

not without alarm, were defective, dangerous, and inadequate to the purpose. Indeed, the omission of the description of the means employed, in the history of the case, (not to mention the result,) justifies the conclusion that they were so. However competent the operator, he could not forge an instrument in a instant, and, to whatever authority his memory might appeal, it would furnish him with no maxim or plan to act upon, other than that he adopted, since the annals of Surgery contain none. Cases of this kind naturally lead us to enquire, how the Surgeon can extricate himself from the dreadful dilemma, of which the above is evidently an example. But, why, it will be asked, perform any operation when the stone is of such a nature? Unfortunately, it is often impossible to form a correct notion of this before the incision is made. There are few Surgeons accustomed to treat the disease, who will not admit, that, frequently, where they had expected to have a small

stone to deal with, it was found voluminous; and the reverse.

The plan which I have thought of proposing, is certainly, in itself, highly dangerous; but, inasmuch as it does offer some hope of safety, it appears to me to deserve to be adopted, in preference to that which the moment may suggest.

As far as the knife is concerned, the process closely resembles the high operation, as performed by Frère Cosme: As in the latter, two incisions are made in the bladder, one below, the other above, the pubes; but neither is to exceed an inch in extent. The stone is to be enclosed in a bag passed through these apertures, and then broken with a forceps, the branches, of which, are to be separately introduced into the bladder, one above, the other beneath the pubes, and afterwards united.

The forceps is of a very simple construc-

tion; it consists of two separate branches, with a moveable lock to unite them at one end, and a strong screw to force them together at the other. The perinæal branch represents a kind of spoon, at that extremity which is to be passed into the bladder; and the supra-pubic, a wedge, terminating a strong piece of steel, which is curved, to adapt itself to the bones of the pubes. The moveable lock or hinge, by which these branches are united, is made to slide backwards and forwards on the perinæal one, where it may be fixed at any given point. The screw is very strong and moves through a solid part of both branches, at about six inches from their vesical extremities.

The bag for enclosing the calculus, composed of silk or thin kid leather, is about ten inches long and three inches in diameter; it is open at both ends, one of which is surrounded by an elastic ring that may be easily closed to pass into the bladder, but sufficiently strong to keep open by its own elasticity. At opposite

points of this ring, strings are fixed, for the purpose of drawing it over the stone.

We will suppose the Surgeon to have commenced an operation of perinæal Lithotomy or Lithotrity, and, on dividing the prostate, to have found the stone filling the bladder, and so large, that he could neither break nor extract it. In this dilemma, he might proceed as follows:—An incision, one inch and a half long, is to be made above the pubes, on the median line, and the bladder laid bare, with the usual precautions, as in the high operation. This organ is then to be opened, from the pubes upwards, to the extent of an inch or rather less. The operator will now have two openings in the bladder, one in the hypogastrium, the other in the perinæum: the urine will escape, but the organ will be supported by the calculus, which may thus be attacked at opposite points. By means of an elastic probe-needle, the strings of the bag are to be drawn through the cavity of the

bladder, from the perinæal to the supra-pubic incision, where they are to be confided to an assistant, who is to draw them up gradually, whilst the Surgeon introduces the bag at the inferior opening, the ring being passed in with a forceps, guided upon the left index of the Surgeon, or upon a conductor. As soon as the ring is fairly in the bladder, it will open, and, being directed with the strings, may be drawn from below upwards, so as to enclose the calculus, the weight of which will act in facilitating the process. When the ring has been brought out at the upper wound, the stone will be separated from the bladder by the thickness of the stuff composing the bag, and will be accessible at opposite points of its vertical diameter. The perinæal branch of the forceps is now to be carried under the stone, through the inferior orifice of the bag, and fixed in the vice; one end of the other branch is to be placed in the hinge, the position of which is to be regulated by an assistant, whilst the Surgeon directs its wedge-extremity through

the upper orifice to the top of the calculus. When the latter is well fixed, between the perforating wedge above, and the strong blade in which it lies below, the operator has only to turn the screw to crush it to pieces. During this part of the operation, the instrument must be held steadily, to avoid jerks, which would seriously injure the bladder. The principal fragments are to be removed with a suitable forceps, and, what remain will come away with the bag, which, after its inferior orifice has been closed, should be drawn through the wound in the hypogastrium. After the operation, a warm, sedative injection may be passed into the bladder. As the urine will come away through both wounds, it will only be necessary to cover that above the pubes with a simple pledget of linen. The pulse must be kept down by two or three small, general bleedings, performed within the first ten or twelve hours following the operation, and the nervous system quieted by a full dose of the Tinctura Opii.

The greatest objection to this plan lies in the difficulty there is to enclose the calculus in the bag,—a process not without pain to the patient and requiring a considerable length of time; a second is the danger of making two incisions into the bladder; and a third may be founded on the ground, that this organ is exposed to contusion during the rupture of the calculus. It is hoped that the first may be obviated by an improved apparatus. With respect to the second, it may be stated, that the two incisions required in this new operation, and which belong also to the plan of Frére Cosme, are small, and consequently much less dangerous in themselves than one large opening made either above or beneath the pubes, for they expose less to infiltration of urine. The bladder may certainly sustain some injury during the fracture of the calculus, but it will amount to little more than severe irritation; for, being protected by the bag, it will not be subjected to distention, or exposed to the action of irregular fragments. In

perinæal Lithotomy, the prostate is considerably bruised by the branches of the forceps, which are necessarily carried asunder to open the blades. In the plan just described, nothing of the kind happens: the foreign body is broken to pieces without any pressure on the bladder at all; a broad spoon is passed under it, and a wedge made to perforate it from above downwards, by a power which is measured and gradual, yet, so great, that the hardest stone yields to its action in a few seconds. Again, we repeat our conviction, that, at best, the operation is dangerous; but, it is proposed only for those cases where death is certain without it; and death has almost always been the sad result of attempts, hitherto made, to extract or break calculi completely filling the bladder: some patients, after remaining an hour and a half on the table, have been conveyed to bed with the stone still in them; others have expired during the operation. I do hope for less fatal results.

Whether it would be justifiable to proceed in the manner we have described, without enclosing the calculus in a bag, experience must decide. To omit it would remove all the difficulty attending the operation, except that inseparable from the extraction of many fragments; and, then, it would be advisable, during the whole process, to keep a small quantity of warm water constantly dropping into the bladder, by means of a funnel adapted to a tube which might be passed into the superior incision.

TREATMENT OF STONE

IN THE

FEMALE BLADDER.

The dimensions of the female pelvis are too well known to require insertion in this place; we need only remind the reader, that each diameter of its outlet presents an extent of four inches and a half. The bladder, situated in other respects like that of the male, is placed before the uterus and above the vagina. It is less conical and broader than in the male, and somewhat flattened from behind forwards. Its basis corresponds to the upper wall of the vagina, and is firmly united to it by dense cellular tissue. It is between the anterior

part of this wall of the vagina and the symphysis pubis, that the neck of the organ is placed, with its centre at about an inch and a quarter below the latter. From this point, the urethra, about an inch and a half in length, and nearly straight, runs forward upon the same part of the vagina, to open, by what is termed the orifice of the meatus urinarius, under the arch formed by the junction of the crura clitoridis. This canal is formed internally of a fine, mucous membrane offering longitudinal folds and lacunæ which are more abundant at its inferior part than elsewhere, and, externally, of a tunic of musculo-erectile tissue, like that of the vagina. Its caliber is greater than that of the male, and it can be much more easily and extensively dilated.

The regions and parts, through which the female bladder may be opened, at the inferior aperture of the pelvis, are of a much less complex nature than those in the male. That portion of this aperture,

which, in the male, is called the perinæum, is occupied by the cavity of the vagina, except anteriorly, where there exists, between the inferior part of the symphysis pubis and the superior wall of the vagina, a small, triangular space, bounded laterally by the branches of the pubes and the crura clitoridis. The basis of this triangle, represented by the wall of the vagina, on a level with the urethra, is about an inch and a half in extent, and its height to the symphysis pubis, rather more than an inch. The pelvic aspect of this space corresponds to the inferior part of the anterior region of the bladder; its superficial plane is formed by the genital mucous membrane, and concealed between the labia externa. Between the two surfaces, we find a few fibres of the constrictor vaginæ muscle, veins, and, at the upper part, the pubic ligament; beyond these is that part of the fascia of the pelvis, which constitutes the anterior ligament of the bladder.

Superficially, under the genital mem-

brane, close to the erector clitoridis muscle, lies the termination of the perinæal artery; and deeper, upon the ramus of the os pubis is the trunk of the internal pudic advancing to the clitoris.

The neck of the female bladder, unconnected with any thing like the prostate, (unless the vaginal wall can be likened unto this gland,) occupies the anterior fourth of the inferior aperture of the pelvis. It is not fixed, as in the male, but retained behind the symphysis pubis only by the anterior ligament. Its lateral parts are embraced much more loosely by the fascia of the pelvis than in man. This disposition was necessary to admit of the displacing of the organ by the head of the fœtus, in its passage through the cavity of the pelvis.

The intense suffering which women undergo in child-bed, is apt to leave on the minds of those who witness it, the impression, that nature has dealt hardly with the female, and subjected her, in the

fulfilment of this portion of her destiny, to pain and tribulation more severe than "flesh is heir to" on the male side; and, many, in contemplating this subject, have attempted, not without reason, to shew that the pleasures and the pains of both sexes are dispensed with a just and impartial hand, by appealing to the more vivid and delicious sensations supposed to fall, almost exclusively, to the share of those, who—

> Blest into mothers, in the innocent look,
> Or even the piping cry of lips that brook
> No pain and small suspense, a joy perceive
> Man knows not* —

But the Anatomist, whose knife enables him to unravel the physical mysteries of our structure, will find, in addition to the compensative feelings to which the poet alludes, further evidence of even-handed justice to man and woman, in comparing with the intricate disposition of parts in

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* Byron.

the male genito-urinary organs, the more simple organization of those in the other sex,—a comparison which leads to the conclusion, that the diseases of the former are far more serious, more painful, and less accessible to the curative art, than those to which the latter organs are liable; and this is what experience proves. There are no pains so acute, or consequences so serious, attending any derangement of the genito-urinary apparatus in woman, to be compared to those which appertain to the diseases of the same organs in man; and, it would not be far from the truth to affirm, that in the male subject, stone alone carries with it torture far exceeding the amount of suffering endured in a multitude of the most painful affections peculiar to women.

In woman, the large size of the pelvis—the shortness of the urethra, situated over a large cavity, serving only occasionally as a canal, and having its walls of a yielding nature—the absence of the prostate

and of those important and intricate parts which make the perinæum so dangerous a region to touch in the male subject—render the disease in question comparatively trifling and easy of cure, and establish the kind of compensation we have just mentioned, as conducing, with regard to the particular circumstances of each sex, to make our life an equal lot.

The bones are widely expanded, in the female pelvis, around the bladder and other organs contained in it, leaving large apertures which admit the passage of the fœtus, and through which the most voluminous calculi may be extracted with facility.

The urethra is so short and dilatable, that concretions, which, in the male, become the nuclei of large calculi, frequently pass off unperceived or without much pain; and those which do not may be easily extracted after dilating the canal.

In those cases, however, in which a calculus happens to remain and grow to the size of an inch and a half in two diameters, it may be destroyed by Lithotrity. The operation, which is more promptly and easily performed than on man, should be regulated by the same considerations relative to the form and density of the foreign body, as belong to its application in the male bladder. But, where the stone exceeds this volume, Lithotomy may be preferable to either dilatation or Lithotrity. An extensive opening may be made without danger, in consequence of the simple structure of the parts. To accommodate the *wound* to the *volume of the foreign body*, which is impossible in the male subject, is here perfectly safe. The cavity of the vagina offers a natural passage for the stone. The parts divided are so thin, that infiltration of urine in the cellular tissue is almost unheard of; there are no vesiculæ seminales to endanger; there is no prostate to lacerate; nor does the peritonæum descend as in the male, so

as to render inflammation of that membrane frequent. Incontinency of urine and Vesico-vaginal fistula are the only evils to be apprehended, and they, it appears, are of rare occurrence. In the few cases, in which, from the large size and excessive hardness of the stone, it may be necessary to have recourse to the knife, Mons. Clemot's plan of operating seems to merit the preference. It consists, merely, in the division of the contiguous walls of the bladder and vagina, just behind the vesical extremity of the urethra. The patient is to be placed in the usual position; the Surgeon introduces a short straight staff, and having recognised the stone, turns its groove downwards, and presses its end against the vagina, in which the left index and a wooden gorget are passed to receive it. When the end of the staff is made to rest fairly in the concavity of the gorget, by pressure exercised on the intervening vesico-vaginal septum, both instruments are to be kept in this position by an intelligent assistant;

and the operator, carrying the knife along his left index placed in the hollow of the gorget, has only to divide, along the groove of the staff, the walls of the bladder and vagina, to a sufficient extent to admit of the extraction of the stone, which is to be drawn out through the cavity of the latter.

To render this operation still more easy, I have had constructed a *sonde à dard*, similar to that used by Mons. Belmas in the high operation, except, that it is much shorter. This I propose substituting for the staff: when in the bladder, its vesical extremity is to be pressed against the concavity of the gorget passed into the vagina; and the operator has only to move forward the sharp steel rod, in order to puncture the contiguous coats of the bladder and vagina. The groove of the rod then becomes the director for a probe-pointed, narrow knife, with which the incision is to be made, from behind forwards. This should be situated midway between the reflection of the peritonæum from the

bladder to the vagina, and the commencement of the urethra.

The following is a recent example of the facility with which stone may be cured in the female :—

Case 10.

A young lady, rather pale and thin, but of a pretty good constitution, had complained of the usual symptoms of this disease, for about three months, when she was put under the care of a Surgeon, who sounded her several times with great care, but could find no calculus. The pain and inconvenience continuing to increase, her parents applied to my friend, Mr. Walker, of Piccadilly, who, after considerable research, discovered a stone, at the back part of the floor of the bladder, and honored me with a consultation on the best means of removing it. The difficulty of touching it with the catheter, the rapidity with which it moved from place to place when

struck, resting sometimes on the floor of the bladder, and sometimes engaging itself in the neck, led us to conclude that it must be very small; and, as the symptoms were by no means urgent, we decided on proceeding by gradual dilatation of the urethra with steel sounds. The escape of a layer of the calculus, composed of the mixed phosphates, which came away with the urine, confirmed the diagnosis as to its presence in the bladder.

Mr. Walker commenced the treatment Dec. 5, when a sound was passed about one line and a half in diameter. The dilating process was continued twice a week, till the commencement of January: at that time the urethra readily admitted a sound four lines in diameter; and, on the 16th of the same month, the patient passed the calculus in making water. It was of the size and shape of a large almond, chiefly composed of uric acid, but partially coated with a thin layer of the mixed phosphates.

GENERAL REMARKS

ON THE

TREATMENT OF CALCULI.

The treatment of stone is in no wise confined to the operations or mechanical measures we have described; we think, therefore, it will not be deemed unadviseable to offer some remarks that may lead to the principles by which the Surgeon ought to be guided, in combining them with such other means as are necessary to render the cure of the disease effectual and permanent. This is the more important, as the operation may be frequently dispensed with, if the disease is treated in its infancy with the care and attention it de-

mands, and with a due regard to its causes as unveiled by chemistry and physiology.

It has been ascertained, that a certain quantity of animal matter is necessary to bind together, and form into a stone, the gravel or particles of which calculi are composed. Without this kind of cement, the disease will continue only in the milder form of a sandy deposit, in some part of the urinary apparatus; and, in general, there will be no stone, unless this matter be furnished either by the kidneys or the ureters, since the disease very rarely proceeds from a nucleus created in the bladder. It is, then, a matter of the utmost importance to look to the causes which give rise to the secretion of this plastic lymph; for, if they can be obviated, the conditions necessary for the formation of calculi, will be removed. It would be a great point gained, even, if we could diminish the tenacity of this animal cement, as calculi would then easily crumble to pieces, or, perhaps, yield to

such solvents as can with safety be made to act upon them, in the kidney, ureter or bladder. Of the nature of the animal matter in question there can be no doubt: the mucous membrane of the tubuli uriniferi and pelvis of the kidney secretes a certain quantity of mucus, which, in a state of perfect health, is diluent and watery, but which, when a certain degree of inflammation affects the parts furnishing it, or, when the blood from which its materials are taken is too rich or fibrinous, becomes inspissated into a kind of glue or cement.

As this is owing, then, either to inflammation of the kidney, or to the too animalized state of the blood we have mentioned, or to both, whatever influences produce these must be considered to constitute a class of causes in which stone originates, or, at least, one material necessary for its formation.

A second class of causes includes those

which produce a sudden and excessive variation in the state of activity of the kidneys, or in the quantity of the fluid which they secrete; and, to a third belong those which arise from the quantity and quality of the solids and fluids taken into the alimentary canal. Under these three heads it will be found that all the influences which occasion stone naturally range themselves. They are not, however, to be considered perfectly distinct, as they generally exist together, or, at any rate, follow each other in very close succession. Indeed, they act in producing one another, at least, thus far, that excess of acid generated in the stomach, and great and rapid variation in the action of the kidneys, have a direct tendency to determine more or less inflammation in these organs.

It has already been stated, that the kidneys are employed to carry off some of the most animalized excrementitious matter, as well as a great quantity of aqueous

blood exerts a double influence in the production of stone; first, by disposing to inflammation, and favoring the secretion of the mucus or plastic lymph we have spoken of; and secondly, because it is one direct cause of the generation of an excess of uric acid, which forms the chief constituent of, at least, two thirds of the calculous productions we are acquainted with.* Hence, in all cases where there is the slightest tendency to this disease, one grand indication will be to prevent the blood becoming too fibrinous, and more especially in those, where this tendency is marked by the existence of an excess of uric acid in the urine. Those who attend minutely to the history of calculous disorders, will always find, that, at some period or other, during their progress, there has existed more or less inflammation in the kidneys; and it is precisely in those countries or districts, where, combined with other circumstances,

* See Dr. Yelloly's Analysis. Philos. Trans.

pertinacity, his brothers who could not leave their habitual business.

Physiological facts leave no doubt that causes of the second class, namely,—those occasioning a sudden change in the state of activity of the kidneys,—may arise from a multitude of circumstances; they act in producing a transfer of the materials of certain secretions from the organs to which they naturally belong to the kidneys, which cannot carry them away properly, and with whose healthy action their presence is incompatible; and, also, in creating by this disturbance more or less inflammation in the urinary apparatus. There is a necessary law, establishing a kind of compensation of functional duty between one set of organs and another set of organs; but, it is quite clear, that when they act for each other, although they may be the fittest and best chosen substitutes in the body, the function is never so perfectly performed as when performed by the organ destined to

execute it. Of all the secreting organs, the skin is evidently in closest alliance with the kidneys: when the cutaneous perspiration is great, the urinary secretion is small, and the reverse; but, since in this interchange of function, the duty, although done, is not done as it ought to be, some derangement must often occur. Whatever produces or requires a sudden, violent, and more or less complete interchange of function from the skin to the kidneys, is a direct cause of stone; first, because when the excrementitious matter, which should be carried off by the cutaneous surface, is transferred to the kidneys, it tends to precipitate the solid particles of the urine in the form of calculous concretions; and, secondly, because this transfer produces, at the same time, the lymph necessary to bind these particles together into a stone, by occasioning more or less inflammation in the urinary organs. It is well known, that any diminution in the cutaneous secretion alters the composition of the urine, causing an increase of

its uric acid, and most probably of its salts. The kidneys, therefore, having the materials of the perspiration to throw off, are necessarily in a state of action somewhat morbid; and, the more frequently this change of action is renewed, the greater will be the liability to the disease. Hence, climate has a great deal to do with the prevalence of gravel and stone: the disorder will prevail most (cœteris paribus) where the state of the atmosphere is variable; where the transitions from heat to cold, and from a dry to a moist air, are great and sudden. Those who live in bleak and damp situations, and especially those whose skin is delicate and susceptible, are very subject to it.

The causes of the third class, however, have probably the greatest share in producing gravel and stone. It had been observed, that diet has a direct influence upon the qualities of the urine, long before we knew that the fluids, which are not converted into chyle, may pass directly

into the mesenteric veins. Whenever the fluids in the alimentary canal are acid, the urine is acid, and when alkalis are administered to a certain extent, it becomes alkaline. We have no direct proof, that there is any kind of diet, in general use, which gives rise to the formation of alkaline fluids in the stomach, but it has been proved beyond doubt, that a certain kind of aliment and a certain state of the digestive functions very frequently produce acid. Now, I have observed, that whenever too much acid is generated in the stomach of a person whose diet consists principally of animal food, there is also a predominance of uric acid in the urine;* and, on the contrary, that when the production of acidulous fluid in the stomach coincides with a poor diet, oxalate of lime is frequently formed in the kidney. These coincidences have occurred so often in the practice I have seen, that I am strongly disposed to

* I owe my acquaintance with several cases of this kind, to my friend, Dr. A. M. Hawkins, of Upper Brook Street.

consider them as causes and effects. It is true, that the fluids taken up by the mesenteric veins have to make one round of the circulation, prior to their arrival in the kidneys; and may, therefore, in some constitutions, undergo a favorable change before they reach these organs; but, there must be a constant relation between the quality of the blood and that of the secretions; and, as these fluids are destined to pass off by the kidneys, the secretion of these organs is more likely to be altered thereby, than that of any others. When the secretion is changed, in the manner alluded to, it follows of course, that more or less inflammation must be produced in the kidneys, the mucous surfaces of which will secrete a thick, plastic mucus. We shall find, then, that stone is produced very frequently, if not in the majority of cases, by an altered state of the blood from which the urine is secreted, arising from its admixture with acid fluids in the alimentary canal; in the first place, because it may contain a disproportionate quantity

of certain substances tending to assume a solid form, and, secondly, because the presence of these tends to occasion inflammation, and the secretion of a viscous cement, by which their particles are united to form a calculus. It is not easy to determine, exactly, in what proportion of cases the disease is occasioned by these influences, but calculi, consisting of lithic acid, or chiefly of lithic acid, and those formed of oxalate of lime, may be often traced to them. Hence, a proper attention to diet and to the state of the stomach is of the greatest consequence in the prevention and cure of gravel and stone. I do not mean, that an acid stomach should always be corrected by alkalis, (for that would be to attack an effect only,) but, by a selection of proper food, in proper quantity, and the adoption of such other means as render the digestive organs strong and healthy. There is no doubt, that an excess of acid may always be neutralized in the stomach by the administration of an alkali; but, when we consider how difficult it is to give the

exact dose required, and, that an excess of alkali may, itself, possibly, become the cause of a vitiated urinary secretion, ought we not to prefer obviating the causes which give rise to the formation of acid in the stomach, by restoring the healthy state of this organ, and confining its action to the digestion of proper food? A certain degree of bodily exercise is absolutely necessary to good digestion, and equally necessary for free circulation in the kidneys, it is, therefore, not surprising, that calculous disorders should prevail in those countries or districts, where, combined with the want of regular exercise, heavy meals are in vogue, whether of coarse or dainty food; for, on the one hand, from the derangement of the digestive process the blood becomes overcharged with the materials of stone; and, on the other, added to the influence of these, in producing inflammation and the matter for cementing them together, is the congestion consequent to the irregular circulation in the

kidneys, produced either by too much, by too little, or by too uneven muscular exertion.*

Although the origin of the disease can be generally traced to the above causes, yet, immunity from its attacks is not always to be purchased by the most rigid observance of rules that are best calculated to remove or counteract them. Urie acid is so easily generated, and so readily separated from the urine in a solid form, that the most transient alteration in the blood of the kind we have mentioned, if it should happen to coincide with other causes likely to derange the circulation in the kidneys, although equally transient, will now and then occasion this cruel complaint. To express my meaning more unequivocally, I should say, that it is not impossible for a man of the most temperate and regular habits to be afflicted with stone, from one single error of regimen. If such a person happened, contrary to his custom, to mingle in his

* See Dr. England, Opus. Cit.

stomach solids and fluids producing, during or after digestion, a large quantity of acid, and after a late dinner of this sort, retired to rest on a horizontal feather bed, the materials of a stone might be furnished by the stomach, and what is necessary to agglomerate and cement them by the congestion in the kidneys incident to long rest on a soft bed. Fortunately, such an occurrence is very rare; but, it certainly does come within the scope of possibility. On the other hand, there are some individuals so strongly constituted, whose system possesses such powers of neutralizing any predominant deleterious substance in the stomach and blood vessels, or of expelling it, and whose organs are so much beyond the reach of irritation or derangement, that were they to pass their whole lives exposed to the most obvious causes of the disease, they might still remain exempt from it. That this apparent anomaly is very frequent, there can be no doubt; it may be explained by idiosyncrasy, that is, the variable degree of perfectness in the different organs of different individuals.

From what has been stated, we think it will be readily acknowledged, that there are no diseases incident to the human frame which require for their scientific and successful treatment, so complete a knowledge of every branch of the healing art, as urinary calculi.

For prophylactic means we must look to the state of the stomach, skin, and kidneys, and examine them and their secretions, in reference to the general constitution or particular organization of the patient. This embraces a wide range of observation, and, as the state of these organs may vary in each particular case, the Surgeon must depend, in the management of it, on his own sagacity for the modification of that treatment, which, although founded upon the nature of the disease, cannot be applied successfully to its different stages and varieties, in different individuals, without the direction of a physiological mind. As a general rule, the skin should be kept healthy and at a proper temperature by suitable clothing, fric-

tion, regular muscular exercise, and the methodical use of cold, warm, and steam baths. Let the stomach receive only the necessary quantity of food, and that, of such quality, and at such time as may be suited to the constitution of the patient and the circumstances surrounding him. The abdominal viscera must be submitted regularly to the degree of stimulus necessary for the due exercise of their functions, by keeping the muscular system in proper activity, and by such aliment and medicines as are in relation with their structure in each individual. Whenever acid is produced in the stomach, during or after digestion, and especially if lithic acid exists in undue quantity in the urine (notwithstanding the observance of hygienic rules,) the bi-carbonate of soda should be given in just sufficient quantity to neutralize the effect of bad digestion. Great care should be taken not to give too much, for the reason which has been already stated: the feelings of the patient will be found the best guide to regulate

the dose. The cause of indigestion, however, must not be lost sight of; the mucous membrane of the stomach should never be forgotten; for, the great art is to choose a diet suited to its physical state and peculiar sensibility. In such diet the patient must persevere. Whenever there is the slightest tendency to gravel, this substance and the urine should be analysed, so that, whatever is in excess may be neutralized by diet and medicine. Little can be added to the rules which Magendie has given us on this subject.* We are informed by this Physiologist, that three kinds of gravel,—the uric acid, the ammoniaco-magnesian phosphate, and the phosphate of lime,—originate in too azotised a diet, or the use of too much animal food. The two first have certainly this origin, and in some cases, the last; therefore, as vegetable a diet as the patient can bear is the ap-

* See Recherches physiologiques et medicales sur les causes, les symptomes, et le traitement de la Gravelle. Paris, 2nd. Edit. 1828.

propriate preventive and remedy. He states that the oxalate of lime-gravel has been traced to the use of sorrel, which contains the oxalic acid; but he does not intimate the cause of it in other cases. From several which have come under my own observation, and from all I have been able to collect on the subject, I feel justified in stating, that it arises from the generation of acid in the stomach, during or after digestion, and in general, that its formation coincides with the use of coarse, indigestible food, in which animal matter does not preponderate. Carbonate of lime gravel and that consisting of cystic oxide are very rare. In all these cases, we must depend a great deal upon washing the urinary apparatus with diluent drinks. Whatever may be the composition of the materials of stone, we can never do wrong by passing a stream of soft fluid through the stomach, blood vessels and kidneys, but it must be unmixed with the food. The thing next in importance to be attended to is the quality of the blood. In all cases where there is any ten-

dency to concretions in the kidneys, the blood must not be allowed to contain too much fibrine, and when it does, what cannot be effected by diet, exercise and bathing, must be done by blood-letting. Where bleeding is necessary, a vein should always be opened, at first, and then, local congestion may be removed by local bleeding. Subtraction of blood must not be had recourse to frequently in the same individual: the object is to deplete, only when the circulating fluid is too rich for the preservation of health. Depletion will be more particularly required, where uric acid and the ammoniaco-magnesian phosphates are generated. If acid form in the stomach, in spite of proper diet, it should be neutralized by the bi-carbonate of soda, no matter of what composition the gravel; but, if the latter exist without the former, we are advised to administer the solvent best suited to its chemical nature. Uric acid gravel should be met by the bi-carbonate of soda; the phosphate of lime, by drinks containing carbonic acid, and

more particularly, by the seltz mineral water. But the other kinds may be treated by alkalis or acids, whichever may be found useful. I have some reason to believe that soda is beneficial in almost all cases, and that nitric acid is useful where oxalate of lime is precipitated in the kidneys; still I should recommend the Surgeon to observe well the effects produced by these remedies. It seems to me, that such medicines do not always act as solvents, and, that by supplying a new acid, we may sometimes prevent the formation of that which has become dangerous; the same may be said with respect to bases. An excess of soda in the system may prevent the formation of lime, as that of nitric acid may supply the place of the oxalic. In no case, however, should we persist in the use of any remedy which increases the disorder, or favors the precipitation of salts from the urine.

The theory, which I here venture to broach, and which suggests the propriety

of attempting to cause, in the system, an exchange of one of the ingredients of certain kinds of gravel for another substance, as well as administering a solvent, is not, perhaps, sufficiently well founded to be recommended without precautions. In one case, in which I administered citric acid against oxalate of lime gravel, I found it succeed perfectly; but the effects of such a plan of treatment must always be narrowly watched. Certain facts, which are familiar to us, seem to render this theory plausible. It will, at any rate, appear so to those who think it possible to eradicate one kind of morbid principle from the system, by the introduction of another more or less similar, as when syphilis is treated by mercury, and when we obtain protection against the small pox by vaccination. Here success may be owing to a law supposed by them to prevail in the system, in virtue of which, only one kind of morbid action can go on at the same time with any considerable degree of intensity; therefore, to such persons it will not appear unreasonable, to suppose that only a certain quantity of acid

can exist in the system, at the same time, under any circumstances; and if so, to expect that the introduction of another acid of a different kind, should diminish the quantity, or prevent the formation of that before generated. And the same may be observed with respect to alkalis. If we possess acids or alkalis, which are, at the same time, solvents of the gravel formed in the kidneys, they should of course be prefered. Thus, carbonic or muriatic acid should be tried for the phosphate of lime gravel; the latter acid, for ammoniaco-magnesian, and nitric acid for that consisting of oxalate of lime.

These means are to be continued in conjunction with others suited to the urgency of the case, when a calculus exists in the kidney or ureter. To the pre-existing symptoms will then be joined—deep aching, or lacerating pain, in the lumbar and iliac regions, subsiding and returning at intervals; hematuria, vomiting, pain in the testicle. We should not forget to advise the patient to remain in the position most

easy to himself. The first thing to be added to the administration of diluent drinks, made slightly mucelaginous, is general bleeding. By this means we not only diminish the force of the circulation, but render the blood more serous, and consequently, more fit to pass through the capillaries of the kidneys. Next to this, is blood-letting by leeches and cupping close to the kidney in the lumbar region; but it must not be had recourse to, even in a feeble patient, until after a vein has been opened. General bleeding should always be adopted first, and carried to an extent sufficient to make a marked impression on the pulse. It is better to repeat it twice or thrice, than to act by local bleeding before the pulse is soft and compressible. Cupping will generally be found preferable to leeches; and it is better to apply the glasses frequently, than to take much blood at one time. During each violent paroxysm, cupping should be performed; and a little blood may be kept constantly running, for several hours, from leech bites, the bleeding being kept up by a large hot poultice

of linseed meal. Sometimes a current of steam directed to the lumbar region and enclosed under several folds of flannel is preferable to the hot bath. The bowels are to be kept open by mild aperients, and, when they are well emptied, should the pain continue violent, opiates and antispasmodics will be found useful. When a stone is engaged in the ureter, gentle but long continued friction from above downwards, along the course of this canal, will be found serviceable. Sedative injections passed into the bladder and rectum are often of use, but they must be employed with care. On the skill with which these divers means are chosen and combined, will depend, in a great measure, the decline of the inflammation, and the descent of the calculus into the bladder. When this takes place, the acute symptoms subside. Our next object is to obtain the expulsion of the foreign body through the urethra. The diluent drinks may now be made somewhat diuretic; the urine should be preserved and examined carefully. After a few days, we may attempt to ex-

tract the stone with Sir A. Cooper's forceps, or to crush it with the three-branched instrument. Were this treatment begun at a proper time, and continued without intermission, the disease would be cured, in most cases, without the slightest danger; but, unfortunately, the Surgeon is not often called in till the stone has acquired a certain volume in the bladder. When there is just cause for suspecting the presence of a calculus there, the patient should be sounded, and should the suspicion be realised, the next thing is to ascertain its chemical composition by analyzing the gravel, and attending to the concomitant symptoms. The general means we have just pointed out should now be associated with those which act more directly upon the foreign body. If the circumstances are favourable, Lithotrity should be performed without delay; but, if there exist any obstacle to the immediate adoption of the operation, we may sometimes attempt to dissolve it by passing, frequently, a current of water through the bladder. By degrees the liquid may

be made to contain a solvent appropriated to the nature of the calculus. The *sonde à double courant* of M. J. Cloquet will be found very convenient for this purpose. It is perforated by two canals, one serving to convey the injection into the bladder, the other for its passage out. A bottle made of elastic gum is the best instrument for propelling the injection.

The advantage of proceeding with the suitable means of cure, in the succession here recommended, will appear obvious, when it is considered, that, at the same time we are preparing the patient for Lithotrity by allaying irritation in the bladder and rendering it capable of containing fluid, we are diminishing the volume of the stone. When the latter exceeds an inch and a half in two of its diameters, and is too hard to yield to Lithotritic instruments that can be passed down the urethra, it will be for the Surgeon to consider the propriety of performing perinæal Lithotrity, as we have recommended, and finally, in those rare instances where patients have

allowed it to increase to such an extent, that it cannot be removed or triturated through one opening, made either in the perinæum or hypogastrium, to decide how far the plan suggested in this work for extreme cases may be applicable.

As a last observation, I would add, that in some few constitutions, when a proper plan of treatment is strictly attended to, a stone may remain in the bladder without much pain or materially shortening life; when large, therefore, no operation should ever be performed without the most mature deliberation. In every case of this cruel disease, it is the bounden duty of the Surgeon, not only to weigh well in his own mind all the circumstances attending it, but, also, to call to his aid the skill and experience of able colleagues.

THE END.

London: Printed by I. M'Gowan.

INDEX TO THE PLATES.

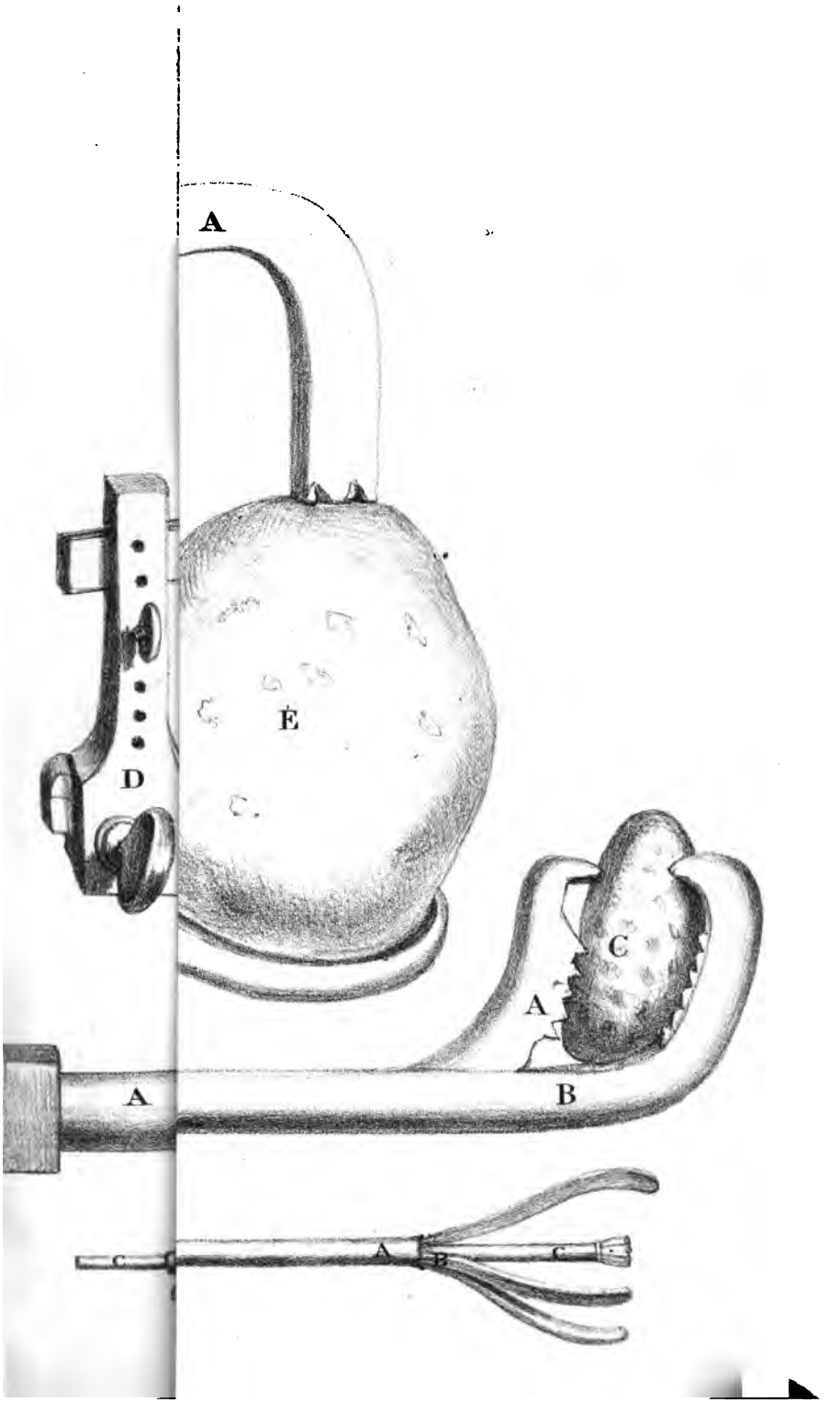
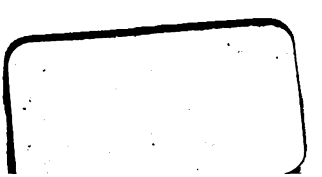
PLATE III.

FIG. 1.—This figure exhibits a side view of the Forceps, invented by the Author, for breaking a calculus that cannot be removed or broken by other means, in double Lithotrity.

A. A. The superior wedge-shaped branch, curved so as to pass into the bladder, over the pubes; B. B. The inferior-branch to be passed under the stone through the opening made in the perinæum. C. The screw for forcing the wedge into the stone. D. The moveable hinge uniting the branches. E. The stone represented about one third less than one which might require the use of this instrument.

FIG. 2.—Represents Mr. Weiss's instrument for breaking the stone, modified by Baron Heurteloup so as to act by percussion. A. A. A. The moveable branch made to slide within the other B. B. B. which is to be fixed in the vice of B. Heurteloup's bed.

FIG. 3.—This figure represents the three-branched instrument usually employed in Lithotrity. A. A. The external tube. B. B. The internal or forceps-tube. C. C. The drill.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